Electrical World

The Consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. XLVIII. NEW YORK, SATURDAY, NOVEMBER 3, 1906. No. 18.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....1139 Monadnock Block
PHILADELPHIA OFFICE.....Real Estate Trust Building
CLEVELAND OFFICE.....1015 Schofield Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
25 shillings. 25 marks. 31 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to September, 1904, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

Copyright, 1906, by McGRAW PUBLISHING CO.

Entered as second-class matter at the post office at New York, N. Y.

Of this issue of the ELECTRICAL WORLD *26,000 copies are printed. Total circulation for 1906 to date, 819,000, an average of 18,614 per week.*

NEW YORK, SATURDAY, NOVEMBER 3, 1906.

CONTENTS.

Editorial 829
Tantalum Lamps 834
Electricity at the Jamestown Exposition 834
Meeting of the Kansas Gas, Water and Electric Association 835
What a Kw-Hour of Electricity Will Do 835
October Meeting of the American Institute of Electrical Engineers 836
Illumination Data 837
Current News and Notes 838
The Grand Rapids-Muskegon 66,000-volt Transmission System 841
Power Plant of the Waltham Gas Light Company, at Waltham, Mass. 843
Engineering Features of the New Altman Department Store Building, New York 846
Electrical Exhibits and Demonstrations in Wanamaker's New York Store 847
Central Station Work in Vermont 849
Central Station Notes from Lincoln, Neb 851
Special Lighting of Downtown Streets 852
Concrete Trolley Poles 854
The Burning of Cheap Fuel 855
Smoke Suppression 856
Some Characteristics of Coal as Affecting Performance with Steam Boilers 857
Boiler Room Economy. By Eugene L. Griggs 859
Selection of a Steam Engine. By Chas. L. Hubbard 859
Letters on Practical Subjects 862
Questions and Answers 868
CENTRAL STATION SALE OF CURRENT:
New Business and Advertising at the Michigan Convention 869
Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under 871
Flat Rates for Small Water Power Plants. By J. S. Codman 872
New Business Campaign at Omaha 873
Newspaper Advertising at Grand Rapids 874
Making a Good Impression Upon the Public 874
A Traveling Window 874
Lamps and Renewals 874
Electricity vs. Kerosene in Residence Lighting 875
LETTERS TO THE EDITORS:
Testing of Lightning Arresters. By Francis H. Bowman 875
Legislative Influence on Meter Inspection. By Ormond Higman 876
Digest of Current Electrical Literature 876
Book Reviews 880
A Recording Instrument. By C. E. Vawter, Jr. 881
Electrical Equipment of a Modern Steam Laundry 882
Decorative Lamp Outfits 883
Oil-Insulated Water-Cooled Transformers 882
Application of Ball Bearings to Motor Shafts 884
The Muscle Shoals Hydro-Electric Power Enterprise 884
Electrical Installation in Ship-Building Shop 885
Holophane Clusters 885
Methods in a Large Repair Shop 885
Equipping a Modern Cement Mill 887
Circuit-Breaker Type Lightning Arrester 887
Interior Telephones 888
Lamp Guards 888
Blue Printing Apparatus 888
Single-Phase Builder's Hoist 889
Industrial and Commercial News 890
General News of the Week 893
Weekly Record of Electrical Patents 900

BREAKING THE VOLTAGE RECORD.

We are glad to extend congratulations to the Grand Rapids-Muskegon transmission system on having raised the high-voltage record fairly out of the region in which it has long been lingering. To have been six months in successful operation at and above 66,000 volts is surely an achievement of which to be proud. For some years the record has been hanging just below 60,000 volts, so that the Michigan plant has lifted it fairly something like 15 per cent, especially in view of the recent additional rise to 69,000 volts. And the best of it is that the work has been done with insulators of reasonable size and without any extraordinary precautions beyond what are usual in sound high-voltage construction. The only material interruption during the six months of service was due to lightning, which split up a couple of insulators. In this instance the grounded wire used on the pole line does not seem to have done its full duty. It would be interesting to know just how it behaved during other thunderstorms, and what protection against lightning will be installed on the new tower line which is planned as a duplicate transmission system. It is certainly very gratifying to find a plain, well-built line with insulators of a simple and well-known type doing such excellent service. It has been the uniform experience that high voltages when once tried have given considerably less trouble than was feared. The climate of Michigan is certainly not exceptionably favorable, nor is the country through which the line runs one that tends to minimize difficulties. Good careful construction has won out and that is about all there is to the matter. The experience here should serve to encourage others to put up voltage into the same region. When it comes to the question of still further increase, new details may have to be settled, and in particular a new insulator with ample factor of safety will be needed. Yet there seems no good reason to doubt that higher figures will soon be attainable.

THE ENGINEERING SOCIETIES' BUILDING.

It is a matter of profound gratification to note the completion of what is to be appropriately known as the Engineering Societies' Building, the gift of Mr. Andrew Carnegie to the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers, which with a score of allied bodies, and a total membership of nearly 20,000 technical men, will now enjoy its superb facilities. Erected at a cost of somewhat over $1,000,000, the building has been finished within time and within the contracted expenditure; and the architects as well as all others concerned are to be heartily congratulated on such a result. The structure is one of the stateliest in the city, a distinct addition to its nobler architecture, while within it is replete with conveniences and opportunities for the work to carry on which the founder and affiliated societies were organized. The auditoriums are spacious and numerous, the office floors are admirably roomy and well lighted, while the library, stack and museum floors at the top of the building invite the creation of the finest engineering library on the continent for practical, useful study and reference.

By November 15 the building will be complete, and on De-

cember 15 the United Engineering Society, the "holding company," so to speak, takes up the active management of its trust. It is already notifying the prospective occupants that they can move in after that date, so that even the current year will see this great endowment of engineering turned to immediate use. About the middle of April, when everybody will be on the spot and comfortably settled, the formal dedicatory exercises are to be held, when the new Engineers' Club adjoining will also be available to take its part in the fitting hospitalities of this notable occasion. It is to be hoped that in some manner due expression will be given of gratitude to Mr. Carnegie, whose interest throughout the work has been great, from the time when he increased his original gift down to the laying of the foundation stone, when he promised to assist at the opening next spring.

In occupying the new building the various societies assume, of course, heavier responsibilities than they have borne before, but this is always the case with larger opportunities, and we believe the burdens will be easily carried. It would be of the best augury, and a notable relief, if the land on which the building stands could be paid for by the opening day, and that sum of $540,000 ought to be available when one considers the resources of wealth in the respective memberships. The electrical engineers have already $133,000 pledged of their quota of $180,000, and the other $50,000 should soon be forthcoming in these days of financial ease and prosperity.

Electricity Over the Counter.

From the practical standpoint in regard to the sale of current, we have rarely published so interesting an article as that which is devoted in this issue to the electrical department in Wanamaker's New York store. This enterprising establishment has installed, as will be noted, a model electrical "flat" so as to demonstrate to everybody the operation and use of practically all the electrical devices and appliances which can be employed in the home for heating, cooking, cooling, refrigerating, ventilating, drying and curling the hair, sweeping the carpets, running the sewing machine, clothes washer or mangle, lighting up a clock by night, throwing on a burglar alarm and for a thousand other comforts and conveniences. Mr. Max Loewenthal, who has organized this really remarkable and striking exhibit, deserves great credit for the emphasis that is thus given to the multitudinous opportunities in domestic electricity, and we are glad to learn that the Wanamaker store is rewarded for its enterprise by the large demand that it has already worked up and is now supplying for apparatus of every character. Indeed, the sales of apparatus are said to be far beyond anything that was anticipated.

Probably part of this handsome return is due to the fact that all apparatus is in "demonstration.' Our point in calling attention to this subject is to suggest that central station companies throughout the country and in every one of the fair-sized cities can secure followers of the example of Mr. Wanamaker, and the stores be made active allies of the central station interests in their respective localities in exactly the same manner. It is said that there are over 400 first-class department stores in this country, and probably a great many others of lesser importance, where an electrical department could be organized whose sale of apparatus at the end of the year would be felt perceptibly in the increased load thrown on the circuits. We believe that if our central station friends were to take up a project of this character they would find that as in New York the manufacturers of apparatus are ready and willing to work with them in the development of the idea. In many cases it might be necessary for the central station companies at first to organize and even conduct the department, but as soon as its utility has been established the department store in each case would doubtless be glad to carry it along. If the department store does not do this the central station company has its own resources at command, or could possibly find some enterprising local electrical supply house to undertake such a "continuous" exhibit. We are, however, surprised to see how rarely the ordinary retail electrical store interests itself in such development and sticks to the old-time stock and show window of a few cells of dry battery, a few coils of wire, a push button and a four-drop annunciator. Just how far each party in the arrangement should go must be a matter of mutual arrangement. It will be noted from our article that the Wanamaker store, in response to the innumerable requests and inquiries it receives from customers, is actually considering the actual installation of the devices and the guaranteeing of the installation. This, however, is not necessary as a general thing, and, in any event, a central station company in any community of ordinary size should be able to keep tab on every new piece of apparatus going on its circuits.

Tests of Tungsten Lamps.

As referred to in this week's Digest one of our German contemporaries has recently published some tests of tungsten filament incandescent lamps, and also of osram filament lamps, which resemble the former in behavior. The price of the tungsten lamp in Vienna is stated to be at present 70 cents, but with a prospect of reduction before long. Their duration of life agrees with that found in some tests in this country, namely, 1,200 hours, though other tests have shown a much longer life. The specific consumption of these lamps is given as approximately 1 watt per mean horizontal hefner, which value corresponds to 1.135 watt per mean horizontal candle-power. The lamps are standard at 60 watts and 60 hefners (52.8 cp in U. S.). The prospects appear excellent for the introduction of tungsten lamps into commercial electric lighting all over the world, after the processes for the manufacture of tungsten filaments shall have had time to be developed and perfected. It is likely, however, that the higher price which is sure to be set for the tungsten lamp at the outset may tend to retard the change, but eventually it is to be expected that tungsten filaments will be manufactured at about the same cost as carbon filaments, so that tungsten lamps will be likely to approach the present price of carbon lamps, although this result may take a considerable period to bring about.

A great advantage of the tungsten over the carbon filament with respect to voltage regulation lies in its increase of resistance with rising voltage. According to the Lux observations, referred to in the Digest, with a 110-volt osram lamp absorbing 37.6 watts and yielding 34.8 hefners, a rise of 1 per cent in voltage, increases the resistance 0.4 per cent, the current 0.6 per cent, the power 1.6 per cent and the light 4 per cent. In the carbon filament the resistance is fairly constant at normal candle-power, so that 1 per cent rise in voltage means 1 per cent rise in current, 2 per cent in power and 6 per cent in light. Consequently, the flickering of candle-power with variations of main voltage is distinctly less noticeable in tungsten lamps than in carbon lamps. The same remark applies to all metallic filaments, such as osmium and tantalum filaments. Moreover, if the voltage across incandescent lighting mains should accidentally increase greatly, it is well

known that carbon filament lamps are apt to be destroyed, or at least to be injured in such a manner that their subsequent life is shortened, whereas the same rise of voltage would have much less injurious influence on tungsten filament lamps. That is, they are less likely to be burned out, owing to their very high melting point or temperature of disintegration, and rise of resistance with current. The increase in illumination from 0.27 to 0.74 mean spherical candles per watt, represents at present a benefit of 170 per cent increase of light for the same cost of energy, leaving aside the cost of lamps and lamp renewals. This is the potential benefit that the tungsten lamp already places in sight. At first that benefit is likely to take the form of more light for the same meter bill rather than the same light for lower meter bills, provided that the tungsten lamp is introduced as a 50-watt lamp. Fortunately for central stations, this rating appears to be the lower limit as fixed—at present at least—by the property of the filament; and fortunately also it involves necessarily a much-needed increase in the present lamp candle-power units. In time, however, it is likely that some of the benefit will take the form of lowered cost of lighting. If we are to judge, however, of the future choice of the community in availing itself of the tungsten lamp by the experience with the Welsbach burner, it seems probable that the advantage will be taken almost entirely in light rather than in money. The new standard of illumination set by the replacement of 16-cp lamps by, say, 40-cp lamps, is likely to be perpetuated indefinitely.

On the other hand, however, the lighting of cottages and small houses by electricity at the lowest rates, that is, the general diffusion of electric lighting throughout the community, is likely to call for the utilization of the benefit of tungsten lamps in the form of smaller units and reduced meter bills. This will be very difficult to bring about on 110-volt distributing circuits, because even 40-cp tungsten lamps on 110-volt circuits have very delicate and fragile filaments. It does not seem practicable at the present time to make tungsten lamps of less than 30 cp for use on 110-volt circuits. But a suitable reduction in the size of the unit can be made by the series connection of lamps, or by a reduction in main voltage. Thus at 55-volt distribution a 15-cp lamp could be made as readily as a 30-cp, 110-volt lamp. In the lighting of small houses it is likely that low distribution voltages must be resorted to unless discoveries are made in new processes of strengthening the metallic filament, or a composite filament of high efficiency and low candle-power range is developed, which conditions it is claimed the recently patented canello filament meets.

A question of detail arises as to the use of 40-cp, 110-volt lamps. If such lamps are used in clear bulbs they are a menace to comfort when exposed to direct vision. It is bad enough to look directly at 16-cp incandescents, where the brightness is about half a candle per square millimeter of filament surface. It would be still more distressing to have to gaze at tungsten filaments glowing with a brightness of, say, 1 candle per sq. mm. The use either of frosted bulbs, or of globes to hide the lamps from direct vision will be of greater necessity than at present. At first sight it would seem as though the loss of light rendered inevitable by frosted glass, or by reflecting surfaces, should be charged to the account of the new lamps; but it is only fair to point out that such methods are already in rapidly increasing use to-day in well-regulated carbon filament incandescent lighting; so that if some 15 per cent of the light is wasted and absorbed in diminishing the initial brightness of the visible luminous sources, the benefit is more than made up both in economy and in comfort. Whatever course may be followed in the development of the new lamps in electric lighting, there can be no doubt that the benefit will accrue not only to the light consumers and the public, but also to the electrical supply industry, provided that central station managers carefully and intelligently study the situation that will be developed by the introduction of the new type of lamp, and have all of their plans for meeting the revolutionary change fully prepared in advance.

DISPLAY STREET LIGHTING.

As the question of display lighting for down-town streets is being considered by an increasing number of business men's leagues, and similar organizations in various cities the country over, the résumé of the plans employed in a number of cities, from the largest to the smallest, which is printed elsewhere in this issue, may be of value to some central station men who are desirous of promoting plans for special lighting of their business streets. This class of lighting, although it usually has to be taken at a very low rate, is a fairly desirable load for a central station because it extends over from four to six hours every evening. The most desirable way to handle these matters is, of course, through a combination of the merchants along a street whereby a uniform scheme of lighting is adopted for several blocks. In one city noted in the article, however, individual contracts are being taken from the various merchants. Of course, at the beginning of such a movement this gives the streets a rather ragged appearance, but the ultimate aim is to close up all the gaps and have a uniformly lighted street from one end to the other.

LOCAL MANAGEMENT OF SYNDICATE PROPERTIES.

While we have in times past noted some of the advantages of syndicate control of electric light and power properties and believe that either by consolidations of properties in the same vicinity or by syndicate control of a number of properties not in the same vicinity, a much higher grade of management may be assured, we cannot refrain from calling attention to the manner in which the theoretical advantages of syndicate control are sometimes entirely defeated by the shortcomings of the local management of a property. In the first place, there is an immense difference in the methods which come under the general head of syndicate control. As one extreme, it consists simply in the ownership of a number of properties by the same group of capitalists. The actual management of the various properties is as independent as if there were no financial connection whatever between them. In other cases syndicate control means that the general management of the property is in the hands of a general manager in some distant city, and the local manager has before him mainly the duty of carrying out a cut-and-dried program mapped out by the general manager. Between these two extremes there is a golden mean, which we believe gives the best results. We will not discuss that now, however, but wish particularly to call attention to the fact that among some syndicate managers and capitalists there is not a proper appreciation of the necessity of good local management.

Some syndicates seem to have the idea when they take a property that the only thing necessary is to overhaul it thoroughly in an engineering way and put it in a physical condition to earn dividends. Once this reconstruction is finished, they seem to

forget altogether the important part that the local management of the company must play in dividend earning. It does not seem to occur to them that no amount of good construction and equipment can make up for a local manager whose business methods and policies are fundamentally wrong or who lacks good business ability and judgment and cannot get along with the public he is trying to serve. The man who can successfully carry on the local management of the business for a central-station company is going to be more at a premium than ever in the coming years.

Capital will hereafter require that the earnings of all central stations come up to certain standards which are considerably higher than those of years past. It will require this because progressive management in many cities has set up these standards. The past few years even some of those connected with other enterprises have not apparently realized what should be obtained from central-station enterprises in which they may have, by accident or otherwise, become connected as presidents or directors. We have in mind, for example, one city of about eight thousand inhabitants in which the central-station company was controlled by men of considerable ability and prominence in the electrical manufacturing and supply field. Yet so little did these gentlemen realize what ought to be accomplished by the local management of the company that the town was for years without any street lighting outside of the down-town district and had very little residence lighting. The station itself was being allowed to go to rack and ruin, and as a last straw, a well constructed municipal plant was being put in before a change was made in the management of the company. This is perhaps an extreme case, but is by no means an isolated one.

Motors on Trial.

The practice of installing electric flatirons on trial has become so general that it is now the accepted method of rapid introduction, although, to be sure, a few companies have gone a step further and are loaning irons for the sake of the extra income they bring in. The practice of installing electric motors on trial is not, however, by any means as common as it should be. Mr. D. W. Low, of Alliance, Ohio, in a paper before the last Ohio Electric Light Association, told of his practice of purchasing motors and putting them in on trial for customers where he was certain that the motor was what the customer needed, and that the customer would be satisfied. Many other companies do this occasionally in isolated cases.

There are, at the present time, too many companies which hesitate to take the risk in carrying such a stock of motors that they are ready to step in at any moment when a possible customer's gasoline engine or steam plant breaks down. The fact that the central station company is on the spot with an electric motor ready to give service as soon as the breakdown occurs has won many a customer. No customer appreciates fully the convenience and economy of an electric motor until he has tried it, and there are always plenty who hesitate a long time before making a trial which will cost them the price of a motor. After they have once had a motor on trial they will gladly pay the price rather than see it go out again and return to the old troubles with gas and steam engines. It is, of course, inadvisable for a central station company to start on such an extensive free trial motor campaign as to tie up an unnecessary amount of money in motors on trial when a customer could just as well have been induced to purchase the motor at the start. But there are plenty of companies where a little more faith in their own product and a willingness to install motors on trial would help the growth of the motor load most wonderfully.

Money Wasted in Advertising.

Money spent in central station advertising properly placed and intelligently looked after is beyond question, as shown by the experience of many, an investment which will bring in returns far in excess of the outlay. On the other hand, there is no surer or more senseless way of wasting money than in neglecting to make the best use of advertising space contracted for. These facts were well brought out in an informal discussion at the last Michigan Electric Association convention. Some central station companies were considering their newspaper advertising as a kind of necessary evil; that is, as something that had to be done to keep the good will of the local press. Stories were told of central stations which had let the same advertisement run month in and month out without change of copy, or without thought on the part of the company as to geting any returns from it. It is not surprising that there were not any returns. The surprising thing is that a company should contract for something which costs it good money and then fail to make the best possible use of what it has contracted for. Few newspaper advertisements are so striking or attractive that they do not need to be changed frequently.

Reputable publishers merely for the sake of their own protection constantly bring pressure to bear on their customers to make the best possible use of the space for which they pay, and thereby get returns on the money spent in advertising. In newspaper advertising especially it is important that every advertisement shall first attract attention and second leave some impression on the mind of the reader. In a trade or technical paper which is to some extent used as a reference list when buyers are in the market for supplies, it is perhaps not as necessary to change advertising copy so frequently or to strive to make it such as will catch the attention of the casual reader. Newspaper readers, however, must have their attention attracted if they are to read an advertisement of electric light and power. Even in technical papers such as the Electrical World, where the advertisements are looked over by many with as great regularity as the reading columns, attractive, up-to-date advertisements which tell the reader something he wants to know are far more productive of returns than those upon which but little thought has been expended.

The Season of Overloads.

For a central station company whose loads are rapidly growing the months of November and December are likely to see the working of every piece of available apparatus up to its full capacity and perhaps a little more. The peak load season of this year promises to be a more anxious season for many central station operators than for several years past, because of the difficulties in getting quick deliveries from the manufacturers. Even companies which thought they exercised ample foresight in ordering apparatus to be installed for taking care of the peak load this season, are finding that the delays of one kind and another will force them to get through the season with the old apparatus. Not only has the general prosperous condition of the country made quick deliveries from manufacturers impos-

sible, but it has tended to cause unusual growth of central-station loads. Last, but not least, there is the general movement all over the country to push actively for new business. And this movement, although only in its beginning, is making itself felt in a demand for more electrical apparatus and supplies of all kinds. It is usually the case that when all attempts at getting new apparatus fail, the central-station man can fall back upon the dealers in second-hand apparatus. But this year the second-hand dealers report applications for many times as much high-grade apparatus as they can obtain.

RESULTS OF THE SUMMER FLAT IRON CAMPAIGN.

The success of central station companies all over the country in the introduction of flat irons the past season, as noted by various items in our columns from time to time and in discussions at state conventions, shows that the electric iron is by no means a difficult thing to introduce and that the revenue obtainable from it is fully up to the predictions we have made. The principal thing limiting the growth of the business the past summer has been the inability of manufacturers to turn out irons fast enough. The revenue to be counted on per month per iron is stated by those who have kept track of this matter to be from 75 cents to $1.00. The most pronounced success in the introduction of electric irons seems to have been experienced by the central station companies in the smaller towns. Some of the smaller central station companies have a record of irons per capita of population which makes the records of the larger companies look very small. There are probably several reasons for this. The principal one is that among the residence customers in the smaller towns the lady of the house is more likely to do a part or all of the ironing than in the large cities. Where the ironing is all done by servants or in an outside laundry, it is more difficult to get an electric iron introduced. The time will doubtless come when this will be changed and no kitchen or laundry will be considered properly equipped unless it has an electric iron. If the lady of the house does some ironing and once tries the electric iron, it is not likely to be returned. Of course, one thing which makes it easier to introduce an innovation of this kind in a small town is the fact that there is more visiting between neighbors and a knowledge of these devices is more rapidly spread than in a city. We are inclined to think, however, that the first reason given is the most potent. In this there is an important lesson for the new business manager of the large company. If he wishes to make his efforts to introduce electric irons count for the most, he will place them on trial among customers in moderate circumstances rather than among the very rich or the very poor.

At the Colorado state convention considerable interest was manifested in plans for getting irons into service more quickly than by sale at cost to the customer. One well-known manager figured that a central station company could afford to sell irons at half cost and charge the other half to advertising for the sake of getting irons on the lines and earning revenue more quickly than by selling at cost. If a central station company finds that the first cost of the iron is limiting its rate of introduction, it should seriously consider whether some plan of removing this obstacle cannot be devised. It would probably not be wise to loan an iron to every customer without any restrictions, because many customers would doubtless put the iron on the shelf and forget about it if it cost them nothing. If they had a little money invested in it, they would use it to get the benefit of their money. Some companies have used a rebate scheme whereby the customer deposits with the company the regular retail price for the iron and this is rebated to him by a credit on his bills for six months or a year. The iron remains the company's property from start to finish, and is maintained in good order by the company. What the customer gives at the start in this case is really simply a deposit which acts as a kind of guarantee that he will use the iron. Although it is not as easy to introduce irons in winter as in summer the number that can be placed during the winter makes the effort worth while and will pave the way for the next summer's campaign.

COST OF KEROSENE LIGHTING.

One does not hear much said at conventions or elsewhere on the competition of kerosene with electric light and yet, as a matter of fact, the kerosene lamp is one of the most important competitors electric light has to-day. To be sure, kerosene lamps have been practically driven out by electricity in stores of both large and small towns. But when we get into the residence districts of the smaller towns, it is the kerosene lamp more than anything else that is preventing many of the small central station companies from making their residence business profitable. The cheapness of the kerosene lamp as a source of light has been taken altogether too much as a matter of course by the central station men. In the matter of cost the kerosene lamp is actually handicapped because it is so inconvenient to light that, once lighted, it will be left burning during an entire evening, so that many lamps must be provided in a house where only a few are wanted at one time. This fact is well brought out by the article elsewhere in this issue giving the experience in a small residence where the maximum electric lighting bills for a year were only $2.17 per month as against $1.50 for kerosene and that with the house much better lighted with the electric light. As a matter of fact, the kerosene lamp in the average home would be an expensive proposition even if kerosene were as free as water on account of the trick kerosene lamps have of smoking up a room occasionally when left to themselves.

The case presented in the article referred to in this issue is by no means unusual or abnormal except that the electric energy rates were a little higher than those prevalent the country over. Some central station men may say that a residence customer whose bills average only $1.28 per month is not worth the trouble and investment, yet although a large enough number of such small customers per block so that distribution expenses are kept down may not give a very large margin of profit, they afford a steady income and are, on the whole, much to be preferred to the big customer who may at any time put in an isolated plant or be secured by some competitor. There is also the possibility of securing additional revenue from flat irons, and once a company has the residence district of a town thoroughly covered, it is better secured against disastrous competition than in any other way. The central station in the small town should not rest until it has taken away from kerosene a lot of the residence business which in former years has been considered hopeless. Central station companies are in a much better position to secure such business than a few years ago when the cost of electric lighting was higher because the smallest electric lamp made was a 16-cp lamp and prevailing rates were much higher than now. In the great majority of the small towns of the country the residence districts are not half covered.

Tantalum Lamps.

In a recent issue of a German electrical journal, the Siemens-Halske Company presents in an advertisement an interesting comparison between the cost of electric lighting with the tantalum and the carbon filament lamp in direct-current circuits. Among advantages of the tantalum lamp mentioned are the possibility of suspending it in any position, its ability to withstand vibrations, its beautiful white light, and especially its very low consumption of power. If the power consumed by a 25-cp and a 16-cp tantalum lamp at the ordinary voltage of 100 to 200 volts is compared to ordinary carbon filament lamps of equal voltage and candle-power, it is found that a saving of at least 50 per cent in power is obtained with a 25-cp lamp, and a saving of at least 30 per cent with a 16-cp lamp. On account of this saving in electrical power it does not take many hours until the higher original cost of the tantalum lamp is compensated for, and a saving in the total cost of lighting results.

Ordinary carbon incandescent lamps at 100 to 200 volts consume in the beginning about 3.3 watts per cp (meaning in all cases mean horizontal hefner candle-power), so that the 25-cp carbon lamp consumes about 83 watts, and the 16-cp carbon lamp about 53 watts. On the other hand, the 25-cp tantalum lamp consumes in the first period of its life 1.5 to 1.7 watt per cp, and the 16-cp tantalum lamp consumes 2.1 to 2.3 watts per cp. The 25-cp tantalum lamp, therefore, consumes on an average only 40 watts, and the 16-cp tantalum lamp only 35 watts.

For ordinary carbon filament lamps an average life of 800 hours may be assumed under normal conditions of operation. The 25-cp tantalum lamp consuming 1.5 to 1.7 watt per cp in the beginning, has a life of at least from 600 to 800 hours, when operated with direct current, and provided the variations of voltage are within proper limits. This figure for the life, however, may be considered as very conservative, since in many cases a life of 1,000 or more hours has been observed. The 16-cp tantalum lamp consuming 2.1 to 2.3 watts per cp has a much longer life, which may be assumed to be at least 800 to 1,000 hours, but is much larger in most cases.

	Tantalum.	Carbon.
Price of lamp.	62.5 cts.	12.5 cts.
Power consumed by 25-hefner cp. lamp..	40 watts	80 watts
Power consumed by 16-hefner cp. lamp..	35 watts	50 watts
Life of 25-hefner cp. lamp.....	800 hours	800 hours
Life of 16-hefner cp. lamp.....	1000 hours	800 hours
Cost of one kw.-hour	3.75 to 15 cts.	3.75 to 15 cts.

From the above table of cost of operation it will be seen that at the rate of 6.25 cents per kw-hour, the cost of using 25-cp tantalum lamps is the same as using the same number of 16-cp carbon filament lamps, while for higher rates for electrical energy it is cheaper to use 25-cp tantalum lamps than the same number of 16-cp carbon lamps.

Of special interest is the calculation of the minimum number of hours for which a tantalum lamp must be used in order to make the total cost of operation (cost of lamp + cost of energy) the same as for ordinary carbon filament lamps of the same voltage and candle-power. On the basis of a price of 12½ cents for a carbon filament lamp and 62½ cents for the tantalum lamp, these minimum hours are given in the following table, both for 25-cp and 16-cp tantalum lamps, at prices of energy varying between 3.75 and 15 cents per kw-hour.

It will be seen, for instance, that at a rate of 10 cents per kw-hour a 25-cp tantalum lamp needs to be lighted only 150 hours and a 16-cp tantalum lamp only 377 hours in order to be as cheap in operation as an equivalent carbon filament lamp.

25-CP. LAMPS.										
Cost of kw-hour—cent.	3.75	5.00	6.25	7.5	8.75	10.00	11.25	12.5	13.75	15.00
Carbon Lamp—										
Energy consumed in 1,000 hours (80 kw-hour)	$3.00	$4.00	$5.00	$6.00	$7.00	$8.00	$9.00	$10.00	$11.00	$12.00
Consumption of lamps in 1,000 hours $\frac{12\frac{1}{2}\text{ cts.} \times 1000}{800} = 15.625$ cents	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16
Total	3.16	4.16	5.16	6.16	7.16	8.16	9.16	10.16	11.16	12.16
Tantalum Lamp—										
Consumption of energy in 1,000 hours (40 kw-hours)	1.50	2.	2.50	3.	3.50	4.	4.50	5.	5.50	6.
Consumption of lamps in 1,000 hours $\frac{\$0.625 \times 1000}{800} = \$0.781$	0.78	.78	.78	.78	.78	.78	.78	.78	.78	.78
Total	2.28	2.78	3.28	3.78	4.28	4.78	5.28	5.78	6.28	6.78
Hence saving per lamp in 1,000 hours	0.88	1.38	1.88	2.38	2.88	3.38	3.88	4.38	4.88	5.38
16-CP. LAMPS.										
Cost of kw-hour—cent	3.75	5.	6.25	7.5	8.75	10.	11.25	12.5	13.75	15.
Carbon Lamp—										
Consumption of energy in 1,000 hours (50 kw-hours)	1.87	2.50	3.12	3.75	4.37	5.	5.62	6.25	6.87	7.50
Consumption of lamps in 1,000 hours $\frac{12\frac{1}{2}\text{c.} \times 1000}{800} = 15.625$ cent	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16
Total	2.03	2.66	3.28	3.91	4.53	5.16	5.78	6.41	7.03	7.66
Tantalum Lamp—										
Consumption of energy in 1,000 hours (35 kw-hours)	1.31	1.75	2.18	2.62	3.06	3.50	3.93	4.37	4.81	5.25
Consumption of lamps in 1,000 hours	.63	.63	.63	.63	.63	.63	.63	.63	.63	.63
Total	1.94	2.38	2.81	3.25	3.69	4.13	4.56	5.00	5.44	5.88
Hence saving per lamp in 1,000 hours	0.09	0.28	0.47	0.66	0.84	1.03	1.22	1.41	1.59	1.78

Price per kw-hour—cents	3.75	5.	6.25	7.5	8.75	10.	11.25	12.5	13.75	15.
Minimum hours for which total cost of tantalum lamps becomes equal to that of carbon lamp.....25 cp.	3.78	2.90	2.35	1.98	1.71	1.50	1.34	1.21	1.10	1.02
16 cp.	8.69	6.90	5.72	4.88	4.26	3.77	3.39	3.08	2.82	2.60

In the following calculations the first cost of the carbon filament lamp is assumed to be 12½ cents, and that of the tantalum lamp 62½ cents. On this basis the saving has been calculated which is obtained with 25 or 16-cp tantalum lamps in comparison with carbon lamps of the same candle-power during 1,000 hours' operation, and for prices of electrical energy varying between 3.75 and 15 cents per kw-hour.

All other assumptions are given in the following table. It may be remarked that 1,000 hours of lighting represents in many plants the average hours of lighting during a year, so that the total saving per 1,000 hours obtained in the following calculations would represent in such cases the saving per lamp per year.

Electricity at the Jamestown Exposition.

It is stated that the lighting of the Jamestown Tercentennial Exposition will be one of the great features of the fair on the shores of Hampton Roads next year. More than 350,000 lamps will be used in illuminating the exposition grounds, piers and amusement devices and many projectors from lofty positions will make the harbor and miles of surrounding country bright. This work is under the direction of Mr. W. M. Dixon, chief of the Department of Electricity. With a corps of electricians Mr. Dixon is pushing the installation as rapidly as the conditions will permit and the wiring in some of the buildings is already complete.

The Auditorium or Administration Building, which is fast approaching its finishing touches, will be one blaze of light, inside and outside, and the electric wires are now ready for the bulbs

that will be placed in position as soon as the structure is completed. The illumination of all the buildings will be of the conventional decorative effect and incandescent lamps will be used through the entire main court and Government pier.

On the Government pier alone will be strung 30,000 incandescent lamps and 62,000 will dispel the darkness on the main court. Besides the incandescent lamps there will be the projectory effects. These will be in keeping with the naval features and will keep the craft at anchor on the waters of Hampton Roads plainly discernible. Fifteen 36-in. projectors will be located on the main court and on the top of a high tower will be placed an 80-in. projector, one of the largest ever built.

The main court and pier will be a treatment of the ornamental standards of illumination, giving a mild, even distribution of light. The majority of these lamps will be concealed from view, but the light will be diffused in a soft glow that will be pleasing to the eye.

On the "Warpath" the lighting will be extremely spectacular. It is contemplated to erect a steel tower 60 ft. high at the head of one of the streets on the "Warpath" and from this 30-in. projectors will flash their rays. This tower will be provided with automatic color screens and in revolving the lights will vary from red and green to white and blue. In addition to this feature the front of the buildings on the "Warpath" will be a blaze of flaming arc lamps.

A complete system of patrol lighting will cover the flower fence that encloses the grounds and numerous arc lamps will be placed at suitable intervals throughout. On the canoe trail and Flirtation Path will be installed the most unique scheme of lighting. More than 1,000 winking or "skidoo" lamps will be hung in the vines and shrubbery on either side of the Flirtation Path and they will wink and blink from 7 o'clock in the evening until midnight. By actual count it is learned that each of these little lamps will wink 14,800 times during the five hours they are in operation. This idea originated with Mr. Dixon and the arrangement of the lamps will be artistic and effective.

For the decorative work at the exposition 100,000 lamps will be used and 150,000 will be operated for illuminating the grounds, including the buildings of the exhibitors and concessionaires.

In installing the electrical wires 150,000 ft. of underground conduit will be used. This includes the wires for the fire alarm system, telephone exchanges and telegraph stations, which will be under the supervision of the electrical department. The Western Electric Company's fire alarm system is now being installed.

Mr. Dixon has been in charge of electrical illuminations at several of the world's greatest expositions. At Buffalo he was assistant to Mr. Luther Stieringer, consulting illuminating engineer. He went to St. Louis as assistant to Mr. Henry Rustin, who was chief of the electrical department at Buffalo, and who died six months after he arrived at St. Louis. Mr. Dixon succeeded him as chief and had entire control of the electrical illuminations at the Louisiana Purchase Exposition, one of the features of that great show.

Meeting of Kansas Gas, Water and Electric Association.

The Kansas Gas, Water and Electric Association held its annual meeting in Lawrence, Kan., October 16-17, fifty-six members of the association being present. The following officers were elected for the ensuing year: President, Mr. E. S. Springer, Leavenworth, Kan.; first vice-president, Mr. C. L. Brown, Abilene, Kan.; second vice-president, Mr. F. L. Williamson, Clay Center, Kan.; third vice-president, Mr. H. F. Jackman, Minneapolis, Kan.; secretary and treasurer, Mr. James D. Nicholson, Newton, Kan. Executive Committee—Messrs. John C. Nicholson, Newton, Kan.; M. A. Patten, Topeka, Kan.; F. D. Aley, Wichita, Kan.

The following papers were read and discussed: Address by President W. E. Sweezy; "Kansas Water Survey," by Prof. F. O. Marvin; "A Problem of the Country Light Plant," by Mr. H. V. Forest; "Composition of Natural Gas," by Prof. E. H. S. Bailey; "Developing a Day Load for Small Central Stations," by Mr. C. L. Brown; "Relation of Kansas University to the Electric Industry of Kansas," by Prof. R. M. Freeman; "The Future: What Shall It Be?" by Mr. F. L. Williamson; "Profitable Cooperation," by Mr. J. Robert Crouse.

The place of next meeting will be Topeka, Kan., and the date October 16, 1907. Several central station managers were added to the list of members. The president and the secretary expect to do some energetic work in the "Wrinkle Department" and to have a good Question Box at the next meeting.

The meeting was considered the best thus far held by the Kansas association and the officers look forward to a bright future for another year.

What a Kilowatt-hour of Electricity Will Do.

The electrical engineer of the municipal lighting plant of Loughborough, England, has recently published a little list showing the inhabitants what a kw-hour of electricity will do for them. It is a good way of selling electricity and of bringing home to the public mind the versatility and wide range of application of electrical energy. Our readers can develop such an idea or table for themselves. Some of the performances are a little vague, but the list as a whole is quite striking and ingenious:

Saw 300 ft. of timber (deal).
Clean 5,000 knives.
Keep your feet warm for 5 hours.
Clean 75 pairs of boots.
Clip 5 horses.
Warm your curling tongs every day in the year for 3 minutes and twice on Sundays.
Warm your shaving water every morning for a month.
Give you 1,250 impressions on a Bremner royal printing machine.
Run a mechanical sieve for 2 hours.
Run an electric clock for 10 years.
Iron 30 silk hats.
Light 3,000 cigars.
Knead 8 sacks of flour into dough.
Fill and cork 250 dozen pint bottles.
Supply all the air required by an ordinary church organ for one service.
Pump 100 gallons of water, or other liquid, to a height of 25 ft.
Run a plate-polishing machine for 21 hours.
Run an electric piano for 10 hours.
Lift 3½ tons 75 ft. in 4 minutes.
Give you 3 Turkish light baths.
Keep 4 domestic irons in use for an hour.
Keep you warm in bed for 32 hours.
Warm all the beds in the house, by a warming pan, for a fortnight.
Give you a fire in your bedroom for an hour while you are dressing or undressing.
Boil 9 kettles, each holding 2 pints of water.
Cook 15 chops in 15 minutes.
Run a small ventilating fan for 21 hours.
Run a large ventilating fan for 6 hours.
Keep your breakfast warm for 5 hours.
Run a sewing machine for 21 hours.
Carry your dinner upstairs every day for a week.
Carry you 30 times from the bottom of the house to the top, 80 ft. each journey.
Keep your coffee pot warm at the breakfast table every day for a week.
Carry you 3 miles in an electric brougham.

The Wireless Conference.

According to the London *Times* the conference on wireless telegraphy now in session at Berlin will decide that the choice of wireless systems shall be absolutely free. We presume it will be considered a gracious concession to inventors and to the public to recognize that they have some rights to the use of the ether.

October Meeting of the American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers, held October 26, the announcement was made that the new Engineering Building will be ready for occupancy by the officers of the engineering societies after December 1. There will be no meetings held there, however, and no opening of an official character until April next, as it is the intention to make the opening rather an important event in the engineering history of the country, with invited guests from foreign parts, and the arrangements for a function of this character will take considerable time.

The evening was devoted to the reading and discussion of a paper by Dr. Lee De Forest dealing with the "Audion," a new receiver for wireless telegraphy. Several forms of the instrument were described. The instrument was exhibited in the form illustrated diagrammatically in Fig. 1.

A low-voltage carbon incandescent lamp is connected to a source of current consisting of a battery of dry cells, a rheostat serving for varying the current at will. Within the exhausted

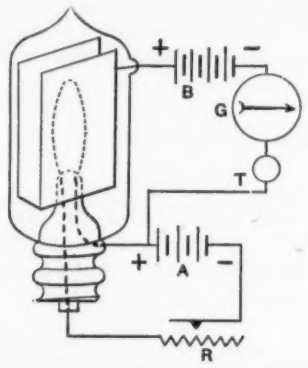


FIG. 1.—ELECTRIC CIRCUITS OF AUDION.

globe of the lamp are placed two platinum wings parallel to the plane of the bowed filament of and about 2 mm. on either side of it. A second battery of dry cells is connected between the positive end of the filament and the platinum, the latter being connected to the positive pole of the battery. Due to the electrification produced in the neighborhood of the incandescent filament, a positive leakage discharge current will pass from the platinum wings through the attenuated gas to the filament. The electrification has been found to depend on the temperature and nature of the filament and on the nature and pressure of the gas, upon the electric and magnetic forces to which the vessel is subjected; the shape and area of the plate or plates, the condition of its surface and edges, as well as its distance from the filament, are also very important factors.

The conductivity of the gas between the wings and the filament increases rapidly with increase of the heating current through the filament, as indicated in Fig. 2. A peculiar and sudden inflection point is noticed in the diagram as the heating current is gradually increased or decreased.

When the audion is connected either inductively or conductively in an oscillation circuit of a wireless telegraph receiver, it forms an extremely sensitive detector of Hertzian waves, giving responses in the telephone receiver (in circuit *B* of Fig. 1) several times as loud as any other known form of wireless receiver when subjected to the same impulses. It is significant that just at the crisp point of the *A-B* curve (Fig. 2) the sensitiveness of the audion to the Hertzian oscillations attains a marked maximum.

It is stated that the device is extremely selective in its behavior with reference to its sensitiveness to waves of different lengths, and it can be closely tuned with the syntonizer, for its operation seems to be dependent upon the sum total of the energy received from the complete wave train rather than upon the maximum first impulse of the train. In other words, while instantaneous as far as our senses or instruments can perceive, its action is sufficiently sluggish to be determined by the additive effect of the entire received electro-radiant energy through a short time interval. By regulating the heating current the potential between the wings and the filament, or the distance between these, the audion can be made to a great extent selective of itself to certain received impulses. The determining factor here is not merely the frequency of the electrical oscillation; the spark frequency or factors determining the total amount of energy received during a very brief unit of time, determine to an extent the amount of its response. Thus with 12 volts across it it may give a loud response to a transmitter, *M;* and with 10 volts "bring in" another transmitter, *N,* to the almost complete exclusion of *M,* although *M* and *N* are of equal power and of approximately the same wave length, but differing considerably in spark frequency. Similar discrimination can be produced by adjustments of the heat of the filament, which also governs the amount of current through the gas.

The audion gives no evidence of fatigue under any conditions of use and requires no adjustment in the receiver itself. Furthermore, it requires no protection from the violent impulses of the transmitter at its own station, whereas the sensitiveness of the electrolytic receiver is completely destroyed by one such violent impulse, unless its small electrode is protected by a shunting switch.

As to the action of the audion it may be stated that a sensitive direct-current instrument in the *B* circuit (Fig. 1) shows a steady deflection varying not a whit, by increase or decrease, during the reception of strong "wireless" signals, so that the effect of the presence of the Hertzian waves seems not to be an increase in the conduction through the gas between the wings and the filament, but rather a momentary change in the specific inductive capacity of the gas considered as the dielectric of a condenser whose plates are the filament and the wings. This operation being repeated for every spark at the transmitter, a listener in the telephone in the *B* circuit will hear a sound whose pitch is exactly that of the spark.

The discussion of the paper was opened by Dr. M. I. Pupin, who commented on the large number of the detectors now in use and proposed, and stated his belief that there has been an unnecessary addition to wireless telegraphy nomenclature due to the fact that each inventor has attempted to give to his detector a distinguishing trade name. In the case of the audion many interesting phenomena are involved, and while they are not well understood it can be stated that their existence has been known for a long time. He stated his belief that the sensitive-

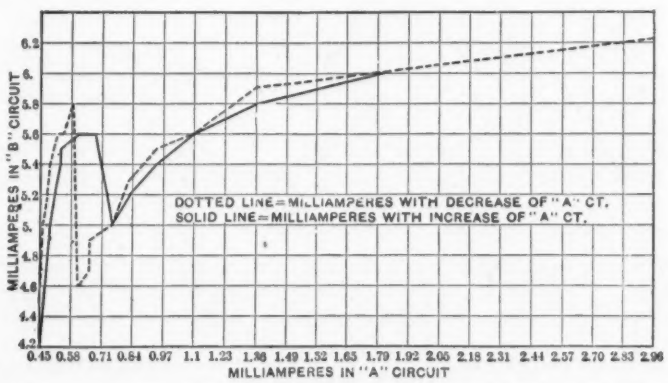


FIG. 2.—CURVE SHOWING CHANGE IN CONDUCTANCE BETWEEN FILAMENT AND WING WITH VARIATION OF CURRENT THROUGH FILAMENT.

ness of the telephone to minute currents has been very greatly over-estimated. In many cases where the telephone has recorded the presence of a disturbance, the disturbance has been largely electrostatic rather than electromagnetic; that is to say, the operation of the telephone receiver can be attributed in many cases to the condensive effect rather than to the inductive effect.

Mr. P. H. Thomas discussed fully the corpuscular theory of the electric current, and drew attention to the fact that the phenomena in the audion are very similar to what are encountered in vacuum tube lamps and mercury vapor lamps. In reply to a question by Mr. Sewall Cabot, Dr. De Forest stated that the sensitiveness of the audion to Hertzian waves of different lengths depends, not only upon the capacity effect, but also upon the

temperature. Thus the audion can be caused to respond to different wave lengths by changing the position of the filament with reference to the platinum wings and also by changing the current passing through the filament.

Mr. J. B. Taylor expressed the opinion that the operation of the audion depends upon a phenomenon similar to that found in organ pipes, which are adjusted so as to be just upon the point of producing a sound when a disturbance is made in the surrounding atmosphere. A similar unstable condition is found to exist in a mercury vapor lamp under certain conditions.

Mr. E. P. Thompson said that his observations of the performance of telephone receivers when subjected to high-frequency currents of very small values fully confirmed the statements made by Dr. Pupin with reference to the electromagnetic and the electrostatic action of the device.

Mr. F. K. Vreeland described the action of the electrolytic wireless detector, in which dry batteries are used as a source of electromotive force for polarization. Experimental observations have shown that the electromotive force current curve of the electrolytic detector, known as the polariphone, shows a certain point at which the detector is extremely sensitive, and this point is obtained by means of the batteries referred to previously. In respect to this action the polariphone is similar to the audion. In the polariphone likewise the Hertzian oscillations passing through the cell serve to depolarize it and to give a signal in the telephone.

Illumination Data.

Mr. J. E. Woodwell, in his paper presented recently before the Illuminating Engineering Society, entitled, "Data on Indoor Illumination," gives the result of an illumination survey made by the Electrical Testing Laboratories of a room occupied by the International Money Order Division of the New York Post Office. The clerical work performed in this room requires a high intensity of illumination, probably not far from 3 to 5 foot-candles of illumination normal to the desk plane. The Cooper-Hewitt lamp was installed experimentally, as the color value does not affect the usefulness of the lamp for this work. The installation has been in service for about ten months, and has, Mr. Woodwell states, given entire satisfaction to the employees who use it. It has the advantage of an efficiency of .60 to .75 watt per candle when installed without reflectors, combined with a low intrinsic brilliancy. The accompanying diagram gives the dimensions of the room and shows the illumination of the lights and the stations at which measurements of the illumination were taken. Following is the report of the test:

Light Sources.—Eighteen 21-in. type H mercury vapor tubes, operating on a 115-volt system, two in series, consuming 3½ amperes, placed 12 ft. 8 in. above the floor. Tubes have been burned 1,000 hours more or less.

The Room Illuminated.—Approximately 61 ft. long, 39 ft. 6 in. wide and 20 ft. 2 in. high. Room finished in cream color with dark woodwork trimmings; furnished with flat-top desks, whose illumination is the chief object of the lighting installation.

The location of the mercury vapor tubes and the points at which the illumination was measured are indicated in the attached diagram. These test stations were selected without reference to the location of the tubes. Stations Nos. 1 to 13 inclusive were laid out at equal intervals, and the numerical average of the values there determined should afford a fair expression of the average intensity of illumination throughout the area which the test stations represent. The remaining test stations were chosen in order to show particular features of the illumination, such as uniformity and general diffusion.

The horizontal illumination at each point was measured at a distance of 30¼ in. above the floor.

METHOD OF TEST.

The intensity of illumination was determined by means of a Weber photometer, especially arranged for work of this character. This instrument, as well as the electrical instruments used, and the observer, were so disposed as to obviate any error arising from objective interference. The lux is used as the unit of illumination in this report. It is equivalent to the illumination produced on a plane surface by a source of 1 cp at a distance of 1 meter, the rays of light falling upon the surface perpendicularly. One lux is equal to 0.093-foot-candle.

RESULTS OF TESTS.

Average voltage of system during test.....115
Total power consumed..... 3.15 kw.

Test Station No.	Horizontal Illumination.
1	35 luces
2	66 "
3	61 "
4	62 "
5	63 "
6	77 "
7	70 "
8	61 "
9	67 "
10	72 "
11	64 "
12	57 "
13	41 "
14—Directly beneath tube	64 "
15	66 "
16—Midway between two tubes	70 "
17	71 "
18	79 "
19	67 "
20	28 "
Average of Stations Nos. 1 to 13, inclusive	61 "
Average of all stations	62 "
Average variations from mean intensity	15%
Maximum variations from mean intensity	55% (Station 20)
Average luces per kw	20

It will be seen that the average horizontal illumination is about 61 luces, or nearly 6 foot-candles, a lux having the value of 0.093 candle. While the illumination is probably in excess of the actual requirements, a satisfactory distribution could not be secured from a smaller number of units; and as the unit used is the smallest manufactured, the horizontal intensity cannot be reduced except by raising the tubes, and this would appear advantageous in order to place the lamps farther from the field of vision. While the intrinsic brilliancy of the unit is low, the combined effect of 6 or more tubes coming within the field of vision from one end of the room is uncomfortable. The reason why no complaint has arisen thus far from this cause is probably due to the fact that during the larger number of hours of lighting service the artificial lighting is combined with daylight of greater or less intensity.

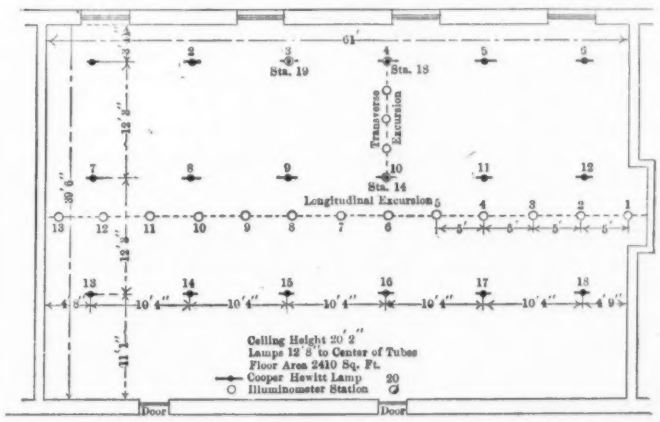


DIAGRAM SHOWING POSITIONS OF SOURCES OF LIGHT.

The Atlantic City Accident.

At Atlantic City, N. J., on October 28, some sixty lives were lost, when an early afternoon train consisting of three cars on the Pennsylvania Railroad Company's new electric line from Camden, went off the drawbridge over the Thoroughfare, a tidal creek, near the popular resort, and plunged into the stream Every person in the first two cars was drowned, as both cars were submerged, and there was no possibility of escape or rescue. The third car hung suspended for a time, affording an opportunity for many of the occupants to get out in safety. It appears that either the drawbridge was not properly closed or that one of the rails was out of place. A sailing craft had just gone through the draw.

CURRENT NEWS AND NOTES.

ILLUMINATING ENGINEERING.—The November meeting of the Illuminating Engineering Society will be held at the Edison Auditorium, 44 West Twenty-seventh Street, New York, at 8.15 p.m., on Friday, November 9. Papers will be read on "Fixture Location in Residence Lighting," by F. N. Olcott; "Fixture Design and Location," by Major E. L. Zalinski; "Location of Lamps and Illuminating Efficiency," by Preston S. Millar.

ELECTRIC AUTOMOBILES.—An Association of Electric Vehicle Manufacturers has recently been formed in New York City with headquarters at 52 Broadway. A meeting is to be held on November 8 to deal with topics of importance. There is also in embryo a National Association of Electric Vehicle Users. A great field of usefulness, it is realized, awaits both bodies, for the electric automobile remains one of the most undeveloped branches of electrical industry.

HARLEM, ILL., ABANDONS MUNICIPAL OPERATION.—The village board of Harlem, Ill., a suburb of Chicago, has decided to discontinue the operation of its water and electric light plant and has given a contract to the Oak Park Yaryan Company, a central station operating in a neighboring village, to furnish light and operate the water works system. The pumping rate is 6¼ cents per thousand gallons, which the board has decided is a saving over the present cost of doing this work at the city plant.

A PRESENTATION.—The splendid work done by President W. Caryl Ely in building up the American Street and Interurban Railway Association during his long and successful administration was fitly acknowledged at the recent Columbus convention when a beautiful bronze statue of "Triumph," on a marble pedestal was presented to him. At the base was a tablet stating that it had been given by the association and the allied societies. The eulogy made by Mr. John I. Beggs on the arduous work of his predecessor was happy in its emphasis on Mr. Ely's "untiring patient ability."

ENGINEERING SOCIETY PAPERS.—The Electrical Engineering Society of Columbia University will hold its next meeting on Thursday, November 8, at 8.15 p.m. in room 301, Engineering Building, at the University. The paper, "Applications and Uses of Direct-Current Motors for Machine Tool Driving," is to be presented by Mr. F. V. Henshaw. All interested are cordially invited. At the last meeting, on October 24, Mr. Henry Pikler, of the Crocker-Wheeler Company, Ampere, N. J., discussed "Transformer Design and Manufacture," in a very interesting and well-illustrated lecture.

EELS STOP PLANT.—Eels have been so plentiful in the Connecticut River that they have caused serious inconvenience to the electric light plant at Bellows Falls, Vt. One day they passed through the racks of the electric light plant flume in such quantities that they clogged the wheels and finally stopped them. It was found necessary to shut off the power, turn off the water and clean the eels out of the enclosure in which the wheels run. Many bushels were taken out. In like manner it is stated that recently the plant at North Pendleton, Ore., was stopped by the sheer accumulation of miller moths on the driving belts, to such an extent that the belts could not be made to operate.

N. E. L. A. QUESTION BOX.—Mr. Paul Lupke, Trenton, N. J., editor of the "Question Box" for the National Electric Light Association, has just issued his circular to the central station field calling for topics. His object in starting the work so soon is to avoid the crowding of material that came at the end of the last campaign, and left a lot of good matter to be carried over. He wishes, moreover, to catch "questions" as they arise in practice, and to get useful answers in the same manner. This year "Wrinkles" will again be combined with the "Box," and Mr. Lupke wants plenty of sketches, photographs, items, etc., as to shop kinks or of contrivances for overcoming difficulties. A neat and ingenious portfolio manila envelope is sent out for use by contributors.

A HEAVY HANDICAP.—A writer in one of the London newspapers summing up the situation to which municipal trading has brought London, says: "The municipal debt has been increased between the years 1898 and 1905 by no less than £62,000,000. At this moment every little Liberal and every little Conservative within the area of Greater London is saddled at birth with a debt of some £17, and an equal burden lies on the shoulders of every Londoner already living. Meantime trading enterprises on which a large amount of these borrowings have been invested are being carried on upon so reckless a system that two of them, the absurd steamboat experiment and the municipal baths and washhouses, are responsible for a joint annual loss of no less than £116,000."

USE OF ELECTRICITY IN BUILDING OPERATIONS.—An interesting application of electricity in the construction of the new Hoffman House at Broadway and Twenty-fifth Street, New York, is attracting much attention from passers-by. On the foundation work a system of heavy interlocking steel piling was used, and owing to the unevenness of the underlying rock the piles projected unevenly above the proper level. To cut off the tops with tools would be slow work and extremely expensive, and it was finally decided to employ the electric current for this purpose. Connection is made with the street alternating-current mains, a transformer reducing the voltage to 50. Carbon electrodes are used and the current quickly burns its way through the heavy steel. The workmen wear smoked-glass goggles and masks of asbestos as protection from the glare and heat incident to the operation.

INDUSTRIAL TRAINING.—At Cooper Union, New York City, on Friday evening, November 16, the Society for the Promotion of Industrial Education will hold a public meeting at which the necessity of industrial education in the United States will be discussed by several persons prominent in the educational and business life of the country. Among those expected to make addresses are Alfred Mosely, the noted British philanthropist; President Butler, of Columbia; ex-Assistant Secretary of the Treasury Frank A. Vanderlip, Mr. Frederick P. Fish and Miss Jane Addams, of Chicago. In the preliminary announcement of the meeting, at which the society hopes to branch out as a national organization, the committee in charge calls attention to the fact that while the United States is much advanced so far as manual training in the elementary and high schools of the country is concerned, in the matter of industrial education the United States is far behind the countries of Europe. Prominent among those interested in the movement is President Henry S. Pritchett, of the Massachusetts Institute of Technology.

PRINCETON IN THE PROFESSIONS.—Figures which have just been compiled from the new directory of living graduates and former students of Princeton University show that the college graduate of to-day is more and more choosing a business rather than a professional career. These statistics show that nearly one-third of the living alumni of Princeton are in business. Exclusive of the class of 1906 there are 7,190 living alumni of Princeton. Of the 6,522 classified according to their occupation, 2,285 are in business, 1,498 in the law, 924 in the ministry, 699 practising medicine, 433 teachers, 290 engineers, 104 journalists, 50 ranching and farming, 50 gentlemen of leisure, 41 students, 34 in the army, 31 civil service, 26 architecture, 19 chemists, 10 artists, 9 authors, 7 in the navy, 5 librarians, 4 musicians and 4 dentists. Among the living alumni of the classes prior to 1841, who number 24, none is engaged in business, prior to 1850, only 5 per cent, and prior to 1870 only 15 per cent. In the 80's the number of graduates following a business career shows a marked increase, amounting to 25 per cent. This percentage remains practically the same for the alumni in the 90's. In the classes which have been graduated since 1900, the increase is very marked, averaging 50 per cent.

MILEAGE OF CHICAGO TUNNELS.—A handsome illustrated descriptive book of the freight and telephone cable tunnels constructed under Chicago streets recently issued by Mr. George W. Jackson lately general manager and chief engineer of the Illinois Telephone Construction Company, gives the total length of street and river tunnels built by that company up to August 1, 1906, as about 43 miles. They are under all the downtown business streets and under a number of streets immediately west of the river. A limited amount of freight haulage is being done at present, using electric mine locomotives and overhead trolley.

THE PRESIDENT AND PANAMA.—It has been arranged that throughout his forthcoming trip to Panama and Porto Rico, President Roosevelt shall conduct the government by wireless telegraph. He will be accompanied on the *Louisiana* by an office force headed by Secretary Loeb, and with the aid of wireless stations ashore and on warships effort will be made to maintain communication with Washington. It is expected that by means of relays of wireless messages the President may be informed of whatever matters of importance may need attention and may issue orders as effectively as when at his desk in the executive offices. Wireless apparatus on the *Louisiana* will be put in perfect condition, and an effort will be made to demonstrate its utmost efficiency in long-distance communication.

PRODUCTION OF PETROLEUM.—During the year 1905, according to the United States Geological Survey, the oil fields of the United States produced 134,717,580 barrels of petroleum, as against 117,080,960 barrels in 1904. This production was greater by 17,636,620 barrels than that of any previous year. It is an increase over the production of the year 1900 of 71,097,051 barrels, or considerably more than any total yearly production up to 1902. The production of petroleum in the United States has more than doubled within the last six years. The increase is in the heavier grades of the fuel class, the production of lighter or illuminating oils having remained constant. The value of the oil production for 1905 was $17,018,056 less than for 1904. The 117,080,960 barrels of oil produced in 1904 were valued at $101,175,455, whereas the 134,717,580 barrels of 1905 are rated at only $84,157,399.

KEOKUK DAM ON THE MISSISSIPPI.—In 1901 Mr. L. E. Cooley, the distinguished civil engineer of Chicago, made an extensive investigation and report on a project to dam the Mississippi River at the foot of the Des Moines rapids near Keokuk, Iowa, and develop power for a big hydro-electric transmission plant. These plans were presented in an address before the Western Society of Engineers at Chicago, in 1902, and are part of that society's proceedings. Since then Mr. Hugh L. Cooper, of New York, is understood to have secured options on the property necessary for the project, and has spent about $100,000 on investigations and preliminary surveys. The project is, of course, a mammoth one, involving a dam 35 ft. high and about 6,000 ft. long and a power house of 200,000 hp. At the Des Moines rapids the river passes through a rock bed so that the conditions are favorable for a dam without excessive flooding of farm lands. The Government has a $5,000,000 canal around the rapids in order to let steamboats pass. If the dam is built this canal will be submerged. A bill was passed by Congress some time ago permitting the submerging of this canal and the substitution of locks at the dam in its place. The capitalists considering the proposition at present are said to be those interested in the Canadian Niagara development.

NATURAL GAS PRODUCTION.—During the year 1905 the value of the natural gas produced and sold in the United States, according to a forthcoming report of W. T. Griswold, of the United States Geological Survey, exceeded that of any previous year by $3,066,099. It amounted to $41,562,855. This was due to a general advance in price rather than to any increase in the quantity of gas produced. Of sixteen States in which natural gas is produced two show a decrease in value in 1905 as compared with 1904. The greatest increase in 1905 was in West Virginia, where it amounted to $1,961,655 more than the previous year. Pennsylvania shows an increase of $1,057,442. Louisiana appeared for the first time as a gas producing State, and notable increases over previous productions were shown by Kansas, Oklahoma and Indian Territory. Kansas showed an increase of 49 per cent over its previous production, and the combined production of Oklahoma and Indian Territory was 161 per cent over the production of 1904.

IRISH INTERNATIONAL EXHIBITION.—The Irish International Exhibition will be held at Dublin from May to October 1, 1907, when a total paying attendance of 3,000,000 persons is expected. Exhibits will be grouped in nineteen sections, in which several countries will be represented. The Machinery Hall is already completed, and in the machinery and transportation sections many well-known concerns will be exhibitors, such as the British Westinghouse Company, Babcock & Wilcox Company. The Machinery Hall is 900 by 100 ft., with a floor area of 92,000 sq. ft. The exhibition site in Herbert Park will occupy 52 acres, and will be reached by three lines of trolley as well as steam railways. The secretary is Mr. James Shanks, Ballsbridge, Dublin, with whom arrangements can be made for space.

SUBMARINE SIGNALS.—It is noted from Washington that on October 24 Major Henry L. Higginson, Robert M. Burnett, Henry Burnett and Charles Merve, representing the Submarine Signal Company, of Boston, visited President Roosevelt and had a conference with Secretary of Commerce and Labor Metcalf, Admiral Reiter and other members of the Light House Board in regard to the extension of the system of submarine signaling. Nineteen lightships on the Atlantic coast are now sending submarine signals and about 125 vessels are equipped with the receiving apparatus, including all the transatlantic passenger steamships of the Cunard, North German Lloyd, Hamburg-American and French lines. The *Alabama* and the *Maine* are equipped and the *Connecticut* soon will be, it is understood. The two latter vessels are to have both the sending and receiving apparatus, so that signals can be exchanged under water in foggy weather when signals by lamps or by sound in the air are impossible. The new submarines now building at Quincy, Mass., also have the double equipment. Europe also has taken up the system and English, French, German and Dutch lightships have submarine bells in regular operation.

CHICAGO TROLLEY FRANCHISE.—The traction companies of Chicago have submitted an ordinance to the transportation committee of the city council for the settlement of the entire traction question. It generally is considered the most liberal offer made to a municipality, circumstances considered. It provides that instead of a permanent franchise for twenty years the companies shall be licensed during good service; that the companies shall pay a fixed percentage from their receipts as compensation to the city; that the companies shall be required to pave, repair, clean and sprinkle the streets occupied by their tracks; that they shall bring their lines up to modern standards and give first-class service; that they shall abandon the train system and operate single cars of modern construction. Universal transfers between companies, except in the downtown district, are provided for. The city may require constructions of subways in the downtown districts in accordance with plans and specifications to be approved by the board of engineers. The companies agree to expend $5,000,000 for that portion of the subway used for street railway purposes. After a five-year period extension of the subway may be ordered by the city, and the companies are to bear their portion of cost as determined by the board of engineers. The city may require the installation of underground trolleys after five years. The lines may be extended every year under order of the city council. The city has a right to compel the payment of penalty in sums to be determined in case the companies neglect to carry out the work of construction or fail to maintain first-class service. In case the penalties prove insufficient, the city may withdraw the operation permit for non-compliance. A percentage of net receipts to be fixed during the negotiations is to go to the city, but the city, in lieu of receiving the compensation, may require the fares to be reduced.

PURDUE UNIVERSITY APPOINTMENTS.—Mr. W. T. Small, B.S., formerly with the Cooper Hewitt Electric Company, has been appointed instructor in the electrical laboratory of Purdue University, and the following gentlemen have been appointed assistants in the same laboratory: Mr. C. E. Schutt, B.S., formerly with the New York Telephone Company; Mr. George Lamke, B.S., and Mr. W. A. Rush, B.S.

MUNICIPAL OWNERSHIP LABOR.—The municipal electric light plant at Crawfordsville, Ind., is struggling with the labor question. The manager of the plant attempted to establish a repair department in order to do his own work. The labor organizations are opposed to this plan and insist that all repairs, wiring and installing of fixtures be done by private contractors. This work has heretofore been done by private electricians, and the labor organizations demand that this plan be continued.

SIGNS IN LOS ANGELES.—After many years of effort the electrical interests of Los Angeles have succeeded in securing the passage of an ordinance which permits merchants to place electric signs over the sidewalk. Each sign thus put up is to be lighted three hours daily, excepting Sunday. It is provided that signs must not extend beyond the curbs; that those attached to buildings must not extend more than 36 in. over sidewalk lines, and that when not in use signs must be swung up against buildings. The citizens expect a great improvement in the appearance of the streets after dark.

MILKING BY ELECTRICITY.—It is stated that the University of Nebraska is planning to install a number of milking machines at the State experiment station in order to test their efficacy and to obtain reliable data. At the State farm a system of records has been kept which dates back 10 years, and it will be interesting to compare the results obtained by the machines with those of previous years. The milkers at the State farm will be run by electricity, the current being taken from the trolley wires of the Lincoln Traction Company. Milking machines are said to have proved a success in New Zealand, where more than 100 are already in use. A number of the dairymen in that country have used them for three years. A few machines are now in use in dairies in Illinois, Iowa and Wisconsin.

EXAMINATION IN BROOKLYN.—The United States Civil Service Commission announces an examination on November 14 in Brooklyn to secure eligibles from which to make certification to fill a vacancy in the position of electrician, at $1,000 per annum, in the Quartermaster's Department at Large, Fort D. A. Russel, Wyo., and similar vacancies as they may occur in any branch of the service. The age limit is twenty years or over on the date of the examination. This examination is open to all citizens of the United States who comply with the requirements. Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the Board of Examiners, at Custom House, for application form No. 1,052. No application will be accepted unless properly executed, including the medical certificate, and filed with the commission at Washington.

CENTRAL STATION STATIONERY.—The New York Edison Company pays a good deal of attention to its stationery, of which it has just sent us a sample batch. It is all excellent advertising matter. The design of each letter head suggests the style of letter to be written thereon—the incandescent border, letter on incandescent lighting. The lighted closet and attachment for reading is used for residence letters relative to home comforts of electricity, while the half-tone paper is distinctly for sign letters. The booklets speak for themselves—one each on "Electric Signs," "Electric Irons" and "Incandescent Lighting." The blotter is for enclosure with the monthly bills and reaches all customers; it is also enclosed with all "follow-up" letters. As already noted, the company has just sent out a special circular bringing tantalum lamps to the notice of its customers. A clever column "ad" in all the city papers the last week brought out the lighting of the new Gorham Building, and a number of minor uses of electrical energy.

TELEPHONY IN INDIANA.—A meeting of the Fifth District of the Indiana Telephone Association was held in Indianapolis on October 18. A large number of prominent independent telephone men were present. One of the principal topics discussed was the advisability of hastening the completion of the Citizens' Automatic Telephone Company's plant in Marion in order to reclaim the local territory now occupied by the United Telephone Company, which was taken over by the Bell Company some time ago. The discussion of this matter resulted in the adoption of a resolution to the effect that all independent companies should remain aloof from any connection with the Bell and make no further contracts and establish no additional traffic relation with the United Company now occupying the local field. Steps were taken to bring about a complete severance of all such relations and to make a general connection of the independents with the new Automatic system now building, which in turn will give them connection with all independent companies in the State.

LIGHTING IN BERLIN.—United States Consul-General Thackara in some official notes on lighting in Berlin states that, as is well known, the supply of electricity for lighting and industrial purposes has for many years been in the hands of a private company, which is required to light the streets at the same price charged for industrial purposes, which is 3.8 cts. per kw-hour. Moreover, the company has to pay the city treasury 10 per cent of its gross proceeds and to give it a share in the clear profits of its business. If the clear profit exceeds 6 per cent of the joint stock up to the amount of $4,760,000 the company must pay 50 per cent of the clear profit; should the joint stock be augmented beyond $4,760,000, 50 per cent must then be paid of the clear profit that exceeds 4 per cent of the capital. Although this contract grants to the company the right to use the streets for electric conduits it provides that competition shall not be excluded. The municipality shall also be entitled in 1915 to claim that the whole electric plant shall pass into its hands on payment of the estimated value. For the fiscal year 1903 the Berlin electric works paid to their shareholders $569,772 and a total to the municipality of $677,419. This is an excellent comparison with the 1899 figures, when $449,820 went to the shareholders and a total of $368,630 to the municipality. For lighting purposes the cost of electricity in Berlin ranges from 7.6 to 9.5 cents per kw-hour. Between the hours of 10 p.m. and 6 a.m. the rate is 7.14 cents. For industrial power purposes the rate is 3.8 cents per kw-hour.

SERVICE IN NEW JERSEY.—The Public Service Corporation of New Jersey has issued an official statement announcing a material reduction in the cost of arc lamps and fixing the kilowatt-hour rate for electric energy at ten cents, to become operative fourteen months hence, or after January 1, 1908. At the same time a readjustment of trolley fare rates in Essex, Hudson and Union Counties, to become operative November 1 next, has been approved. It was also resolved to make a flat net rate of $1 per thousand cubic feet for gas in every municipality where that rate does not at present prevail after January 1, 1909, except in Bergen County, where the rate will go into effect January 1, 1910, the same time the reduced rate for electric energy becomes operative in that county. In fixing the proposed electrical energy schedule the directors have authorized President McCarter to announce that bids for renewals of public electric lighting contracts for a period of five years after January 1, 1908, should be on the following basis: Cities of the first class, for arc lamps of 2,000 cp, $75; all other cities, $80; municipalities other than cities, $85. The latter rate has been in force under short term contracts for several months in Harrison, Kearney and West Orange and Orange. In this city the rate is $95 under a five-year contract executed in 1903. Under the new offer large towns and townships like Montclair and Bloomfield, it would appear, cannot secure as favorable terms as pocket boroughs like Sea Isle and Ventnor cities. In referring to the flat rate reduction to ten cents per kw-hour for energy everywhere except in Bergen County in 1908, and in the latter place in 1910, the company states that when in 1903 it acquired control of the several companies in its system the prevailing rate per kw-hour for electric energy ranged from twenty to thirteen cents, and now scales from fifteen to twelve cents.

The Grand Rapids-Muskegon 66,000-Volt Transmission System.

SINCE April 1, 1906, the Grand Rapids-Muskegon Power Company, of Grand Rapids, Mich., has been transmitting power at 66,000 volts. For some time recently the voltage has actually been 69,000. The accompanying map (Fig. 1) shows the transmission lines, power stations, sub-stations and territory served by the company. The 66,000-volt transmission line from Rogers Dam with branches to Grand Rapids and to Muskegon totals about 75 miles. The distances between various important points are given on the map. The power house at Croton Dam has not yet been completed. The present transmission is from Rogers Dam by way of Casnovia switch station to Muskegon and Grand Rapids. Power for operating the Grand Rapids, Grand Haven & Muskegon Railway and the Grand Rapids, Holland & Chicago Railway is all supplied by this company, part of it being stepped down from 66,000 volts for use in the rotary converters at sub-stations near the ends of these lines, the remainder being stepped down to 19,000 volts for transmission over high-tension lines owned by the railway companies for transmission from their steam power houses before the present water power plant was built.

Fig. 2 is a view of a pole line crossing swampy ground. The wires are placed 6 ft. apart. On the top cross arm at the left is a No. 6 iron wire which is grounded every fifth pole for lightning protection. Locke insulators are used 14 in. in diameter

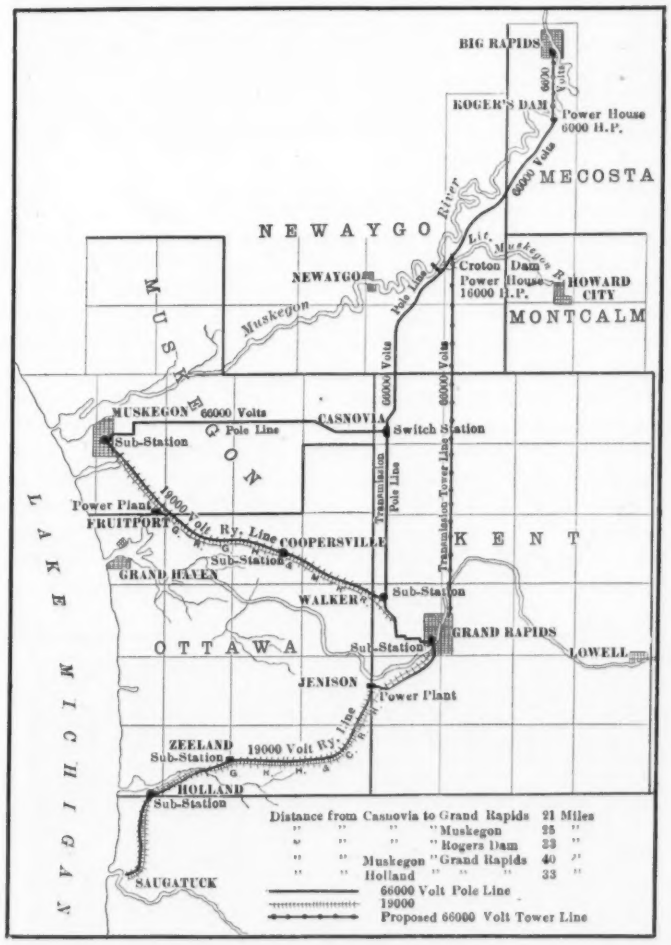


FIG. 1.—MAP OF TRANSMISSION SYSTEM.

over all and 18 in. high. Wooden pins are used on straight line work and iron pins on the corners. These pins are 18 in. over all and 2 in. in diameter under the shoulder. The same dimension of pin is used for both wood and iron. The transmission line conductors are No. 2 solid copper wire. Poles are from 45 to 60 ft. long, none less than 45 ft. being used. They are of Michigan and Idaho cedar and Southern cypress. Forty poles are placed per mile. A right of way from two to four rods wide was purchased. Besides the 66,000-volt pole lines now in operation, which are shown on the map, a transmission line on steel towers direct from Croton Dam to Grand Rapids is planned as indicated. This line will be of at least 66,000 volts and possibly may be operated at 100,000 volts. This line and the Croton Dam power house will probably be completed next May. The tower line with the existing pole line will give a duplicate line between Croton Dam (which is the largest power house) and Grand Rapids. The principal object of the duplicate line is stated by the management to be to avoid interruptions due to local thunderstorms. Thunderstorms in this locality are very local in character and a storm affecting one line might not affect the other. The new steel tower line will be on triangular steel towers 500 ft. apart, similar to the Canadian Niagara tower line.

FIG. 2.—66,000-VOLT LINE, GRAND RAPIDS-MUSKEGON POWER CO.

The operation of the 66,000-volt line up to present writing has been entirely satisfactory and as free from trouble as any high-tension line. The only interruption was that due to the shattering of two insulators by lightning, these insulators being on the two poles next to a railroad crossing. The insulators were split in two by the discharge.

The grounds for the grounded wire are made by burying a coil of copper wire under every fifth pole. Static interrupters, choke coils and Westinghouse lightning arresters are placed at the power and sub-stations. The power plant at Rogers Dam near Big Rapids, which is now in operation, has an average capacity of 6,000 hp. The minimum flow of the river will give 4,000 hp. The head of water is 45 ft. There are two 15,000-kw, direct-connected, three-phase, revolving-field, Westinghouse 6,000-volt, 30-cycle generators with exciters on the same shaft. Each of these generators is connected to two pairs of Leffel horizontal shaft turbines running 225 r.p.m. The turbines are 45 in. in diameter and are of the center discharge type. Lombard water wheel governors are used, with Tirrill voltage regulators on the generators. There is one bank of three 1,200-kw transformers in this station, the excess capacity being provided so that in emergencies the output of the station may be delivered through two transformers. Oil switches are provided in both the 6,600-volt primary and 66,000-volt secondary circuits. The 66,000-volt coils are connected delta.

Figs. 3 and 4 show Rogers Dam and its power house. Figs. 5 and 6 show the construction work now going on at the larger plant at Croton Dam. This Croton plant is to have a capacity of 16,000 hp, the head being 50 ft. Two 3,000-kw generators will be installed at the start. Each generator is to be direct-connected to four pairs of turbines. Besides these two plants the company has purchased water rights for three and possibly four more dams along this river so as to give it a total of 60,000 hp.

The sub-stations at Grand Rapids and Muskegon are fire-proof buildings provided with cranes for handling apparatus. Each has three 1,200-kw transformers stepping down from 66,000 to

6,600 volts. A 1,000-kw motor-generator changing from 6,600 volts and 30 cycles to 2,300 volts and 60 cycles is being put in and contracted to supply power to the Grand Rapids Edison Company and to several large factories. The Brunswick-Balke-Col-

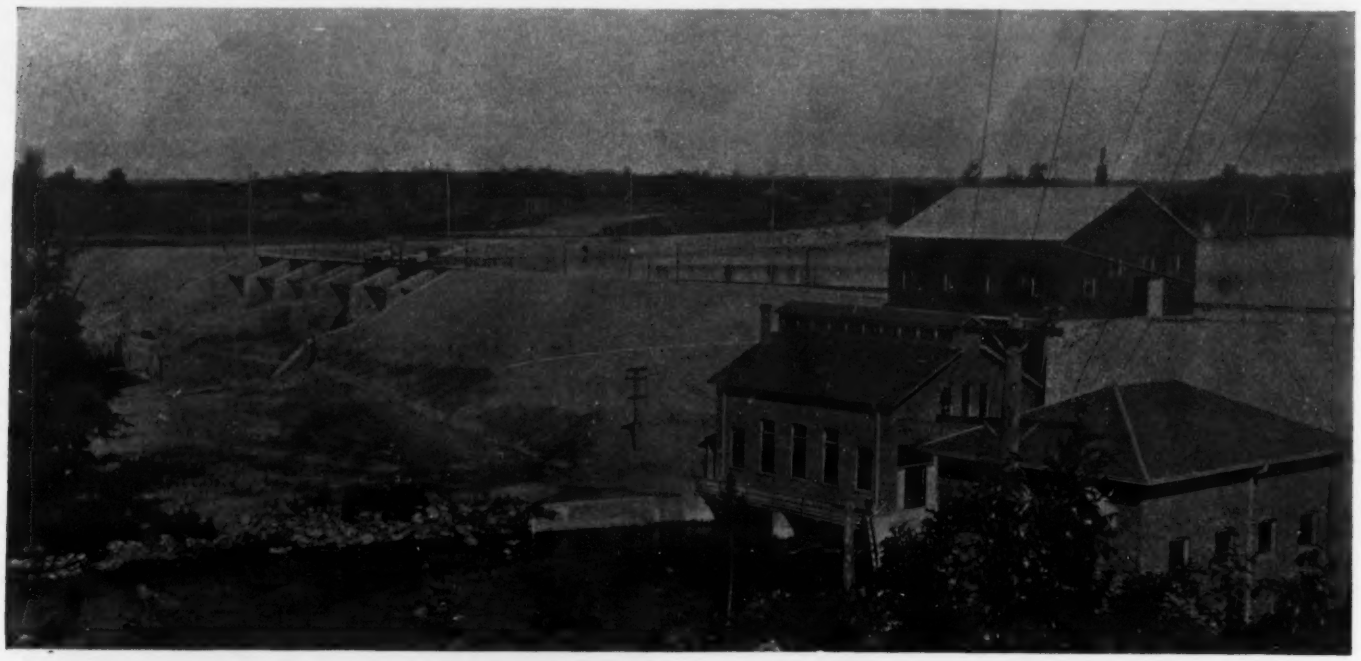


Fig. 3.—Power House at Rogers Dam.

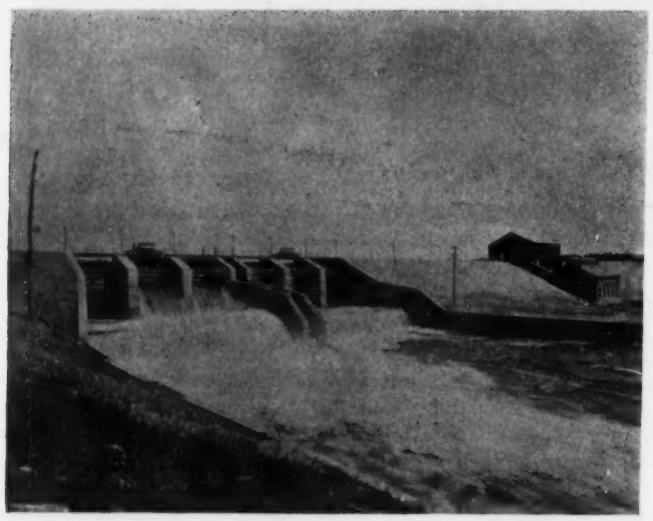
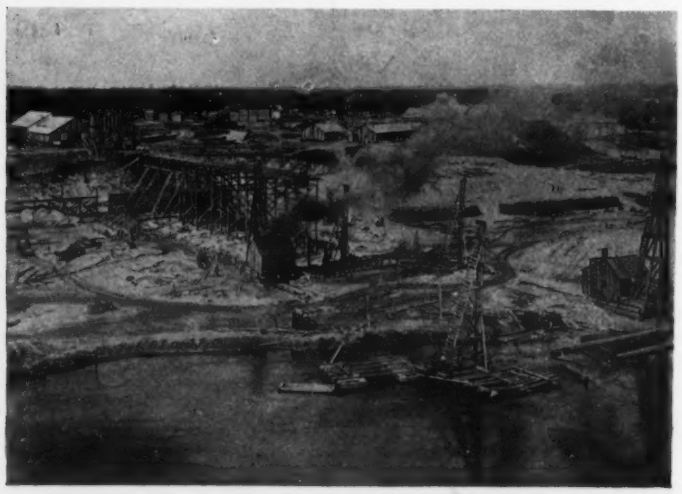


FIG. 4.—ROGERS DAM.

lender Company, a large manufacturer of billiard room furniture and supplies, recently moved its factory to Grand Rapids, one of the things which influenced the change being cheap electricity. This company takes 800 hp. The Shaw Electric Crane Company takes 400 hp. There are many other large factories in Grand Rapids which are now or will soon be connected, these factories being now operated by their own steam plants. At present all of the power developed at the Rogers Dam is being sold and delivered, the work on this dam being started only a year before the plant itself was started. A force of 125 line construction men has been worked continuously. When the second dam at Croton is completed the company will go into commercial lighting in Grand Rapids.

The capitalization of the company stands as follows: Capital stock—Preferred 6 per cent cumulative, authorized, $1,500,000; issued, $600,000. Common, $1,500,000 authorized; $1,500,000 issued. First mortgage bonds—Reserved for issue under restrictions in the trust deed, $6,329,000 authorized. Total bonds outstanding, $1,171,000. The company's general offices are at Grand Rapids. The manager is Mr. Anthony J. Bemis, to whom we are indebted for the information contained in this article. The hydraulic en-



Figs. 5 and 6.—Croton Dam Construction Work.

a 1,000-kw rotary converter has also been ordered and will be installed later on.

As before stated, the company is supplying all the power to the two interurban roads operating into Grand Rapids. It also has

gineer was Mr. W. J. Fargo and the electrical engineer Mr. J. B. Foote, both of Jackson, Mich. The officers of the company are: President, Thomas Hume, Muskegon, Mich.; vice-president, W. A. Foote, Jackson, Mich.; treasurer, J. G. Emery, Muskegon, Mich.

Power Plant of the Waltham Gas Light Company at Waltham, Mass.

THE new power house of the Waltham Gas Light Company at Waltham, Mass., is a notable example of the adoption of concrete to such construction; besides exhibiting in other particulars the most advanced practice in the design of stations of medium capacity for lighting service. The plant generates electricity for incandescent and arc lamps and for motor uses; and electricity is also supplied for the operation of the street railway system.

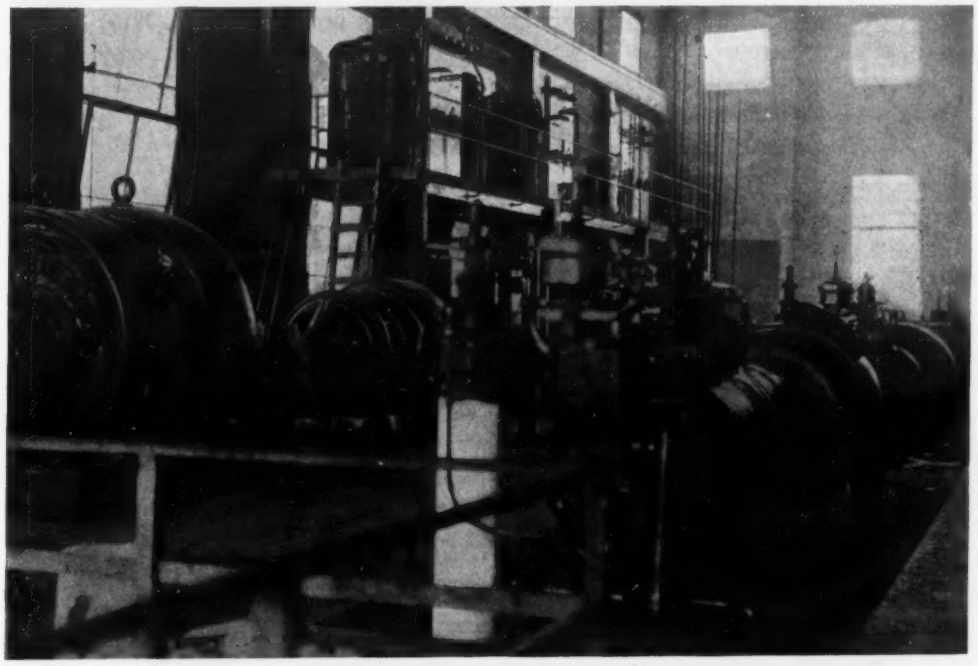


FIG. 1.—VIEW OF ENGINE ROOM, SHOWING MAIN TURBO-GENERATORS, MOTOR-GENERATORS AND TRANSFORMER GALLERY.

The general dimensions of the building are: Length, 157 ft.; breadth, 80 ft., and height, 65 ft. above the boiler room basement; with a chimney 175 ft. high and 8 ft. 6 in. in diameter at the top.

The framework of the building is the conventional steel skeleton. Aside from iron and steel, the only material entering into the construction is concrete, which composes the side wall, roof and interior curtain walls. The side walls were placed in position by means of forms fitted with beveled strips to make imitation joints and to relieve the effect of flatness on the outer surface. The roof was made as flat as possible, a heavy wall and cornice being provided to enhance the architectural merit of the structure.

The results sought in the design have been so far achieved that the finished building has an exceedingly pleasing appearance of simple beauty combined with stability. This is of more than ordinary consideration, inasmuch as the plant fronts on a residence street where a power house of conventional design would present an incongruous effect at least. As it is, the structure is in entire harmony with its environments so that its presence would hardly be noticed by a casual observer.

The building is divided longitudinally by a wall through the center, the boiler room being on the north side, towards the Charles River, which affords ample water for condensing purposes, while the engine room is on the south side towards the street. The main equipment at present consists of four 350-hp Stirling water-tube boilers arranged in batteries of two each, and two 500-kw Westinghouse turbo-generator sets. The turbines are built with ventilating ducts to reduce the noise of operation to a minimum. There is provision for an ultimate capacity of 3,000 kw embodied further in a 500-kw direct-connected cross-compound engine and generator, and a turbo-generator of 1,500 kw capacity. The necessary boiler space for this equipment has been provided. The boilers are equipped with Foster shaking grates and the working steam pressure is 175 lb.

Coal is delivered in cars over the Boston & Maine Railroad to a side track next the boiler room of the power house. A hopper under the track receives the coal, whence it is delivered to a crusher in the boiler room basement, driven by a 25-hp, direct-current motor.

From the crusher in the basement the coal is elevated in a bucket elevator 65 ft., to a rubber belt conveyor 18 in. wide, which distributes the coal to the various bunkers located over the firing floor in front of the boilers. These bunkers have a capacity of three days' supply at full plant load, and discharge through chutes to the firing floor as shown in Fig. 6. In each chute is a weighing hopper which automatically weighs the coal used. The plan view and cross-sectional elevation of the power house show the circuit of the coal from the cars to the boilers. The

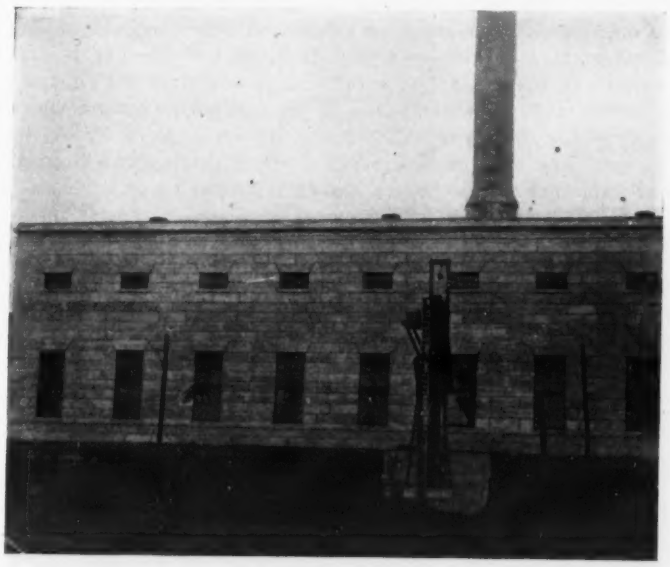


FIG. 2.—BOILER ROOM SIDE OF STATION, SHOWING COALING FACILITIES.

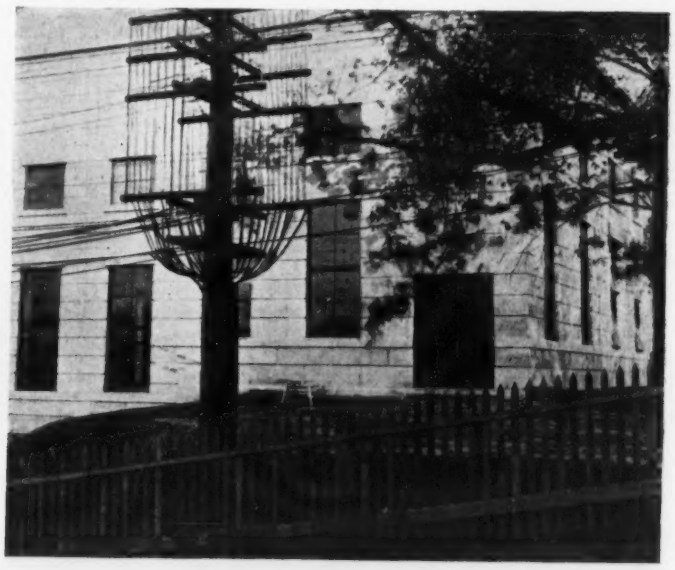


FIG. 3.—MAIN CABLE TERMINAL.

ashes are removed in cars running on an industrial track in the basement of the boiler room directly beneath the chute leading from the ash-pit.

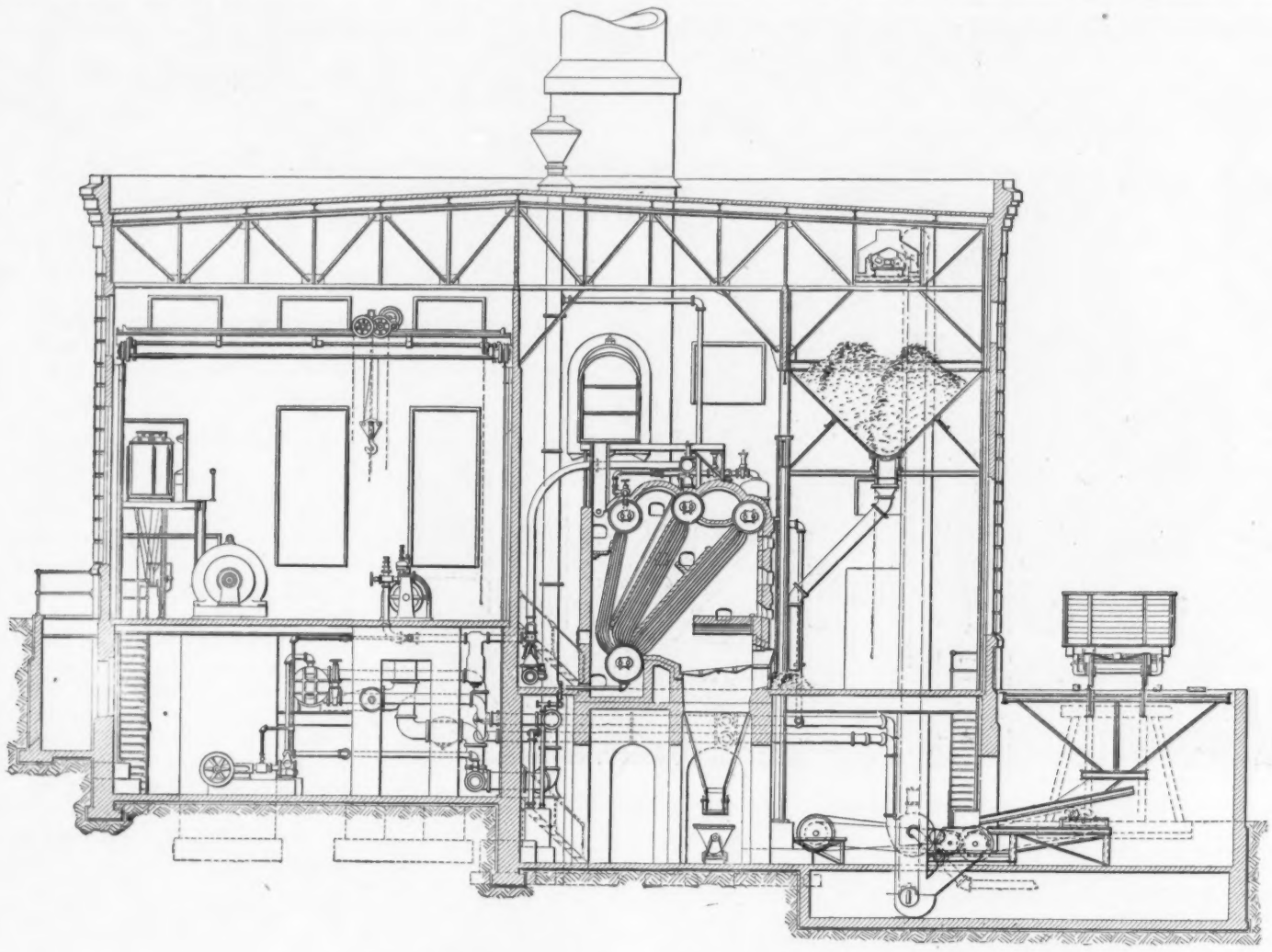


Fig. 4.—Cross-Section of Power House.

The circulating water for the condensing system is taken directly from a well located 50 ft. from the boiler room towards the river and connected therewith by an intake conduit 440 ft. long and 10 sq. ft. in area. The discharge conduit back to the river is of the same area. The circulating pumps are of the double-suction, centrifugal type, direct-connected to vertical steam engines. They are located in the boiler room basement next the outer wall. A storage tank for feed water with a capacity of 232 cu. ft. is located on a steel framework in the boiler room about 10 ft. above the boiler room floor and next the chimney. From the tank the water passes to the feed-water pumps, which are duplex, double-plunger, double-acting units, 10 in. by 6½ in. by 10 in. The water passes from the pumps through two Goubert feed-water heaters having an aggregate of 500 sq. ft. of heating surface. The feed-water heaters discharge directly into the distributing mains. The steam from the auxiliaries, most of which are steam-driven, is used in the feed-water heaters.

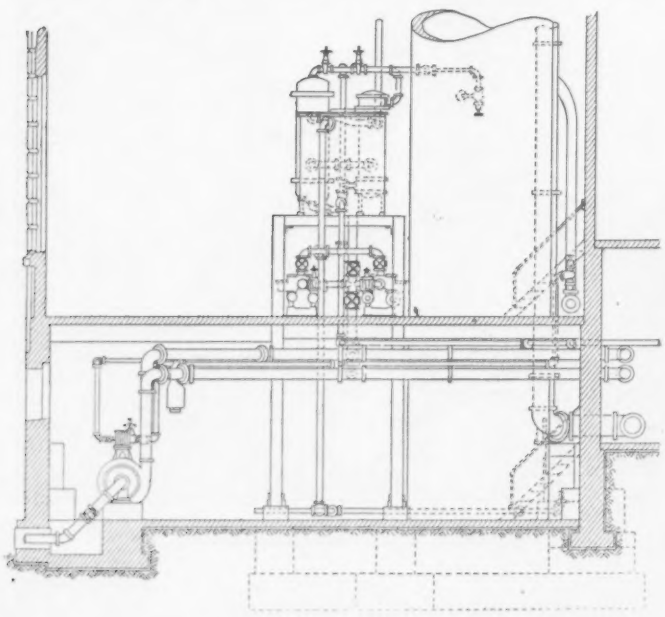


FIG. 5.—SECTION THROUGH BOILER ROOM, SHOWING FEED AND CIRCULATING WATER SYSTEMS.

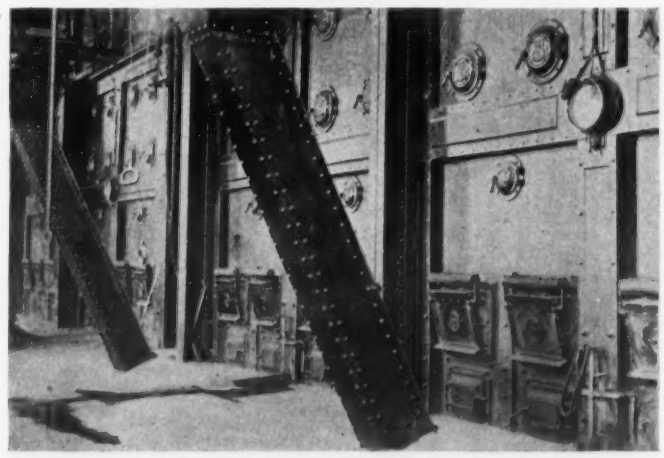


FIG. 6.—VIEW OF BOILER ROOM.

Each turbine is supplied with an Alberger surface condenser. The air pumps are of the rotative type, 6 in. by 14 in. by 10 in. From the hot well the water is returned to the storage tank by means of a small duplex pump. The piping in general is designed with the idea of securing flexibility, and wherever possible the steam and feed-water piping has been practically duplicated by the use of the ring or loop system.

The excitation current is furnished by two double-cylinder Westinghouse engine-generators. For the supply of direct current for the street railway circuits there will be considerable motor-generator equipment provided. The motor-generator equipment so far installed consists of two units of 400 kw capacity and 120 kw capacity, respectively. The larger unit is driven by a synchronous motor and is made self-starting by a small induction motor on the main shaft. The smaller unit, on the other hand, is driven by an induction motor.

The arc lighting, which constitutes nearly half of the present load, is provided for by three General Electric 60-kw constant-current transformers and three 17-kw constant-current transformers of the same make. The control of the electrical apparatus is effected by a Westinghouse switchboard constructed of blue marble. The switches and conductors for the 2,200-volt current are carried on an iron framework behind the panels; only the direct current and the current for the instrument transformers being carried over the panels themselves. This arrangement conforms to best practice, placing a premium on safety, reliability and simplicity. The switches are mechanically operated.

Two sets of high-tension bus-bars are provided, one of which is connected to a voltage regulator. All machines are so arranged that they may be connected to either set of bus-bars. By this means fluctuations in the motor circuits are prevented from affecting the lighting circuits. The commercial lighting load is fed from six single-phase feeders provided with booster regulators, so that the voltage may be adjusted at any point desired. The arc lighting, as noted before, is fed from constant-current transformers.

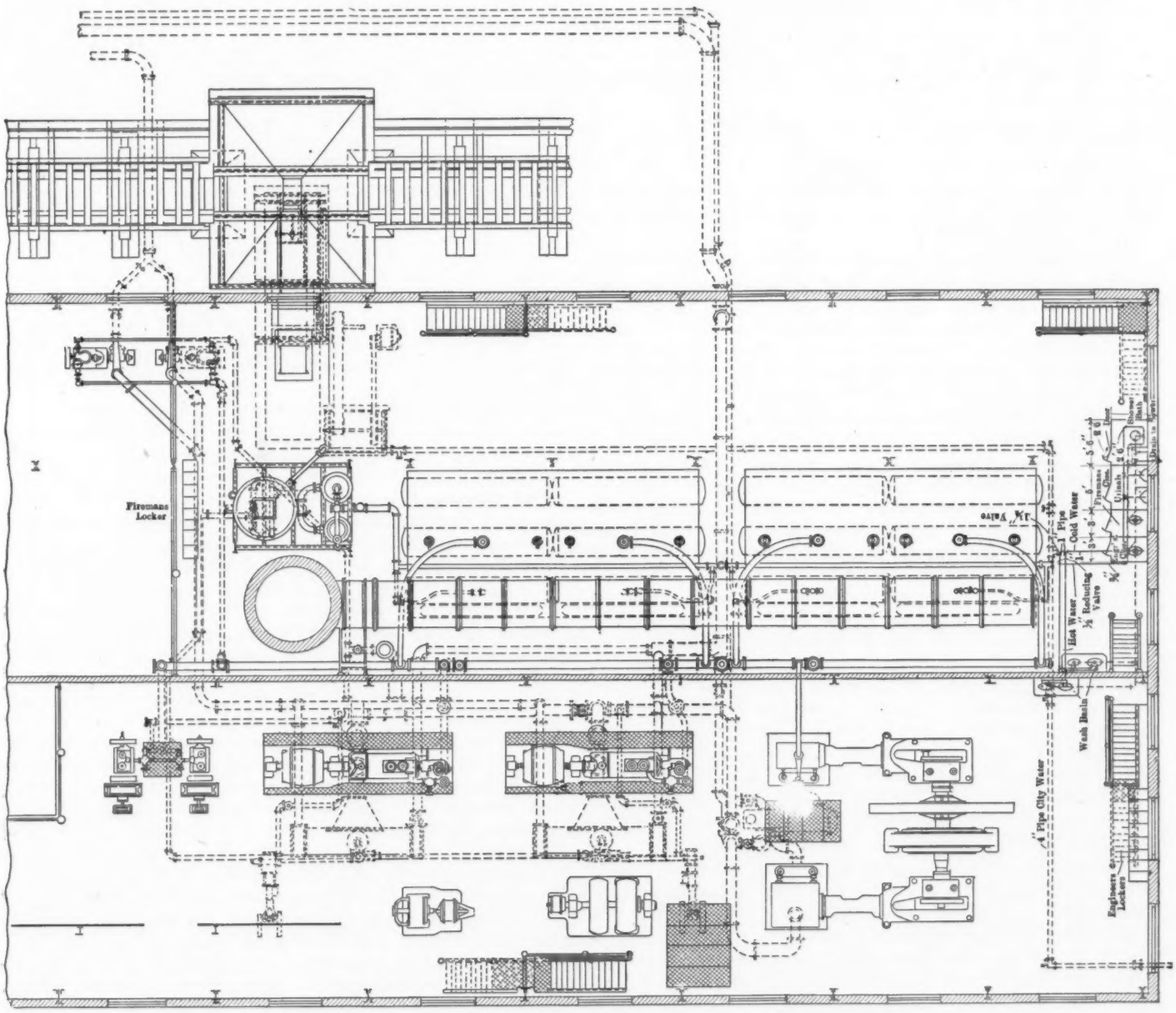


FIG. 7.—PLAN OF THE WALTHAM GAS LIGHT COMPANY'S NEW POWER HOUSE.

The new plant is planned to replace the old station of the Waltham Gas Light Company, which is still in operation. The equipment in this latter plant consists of one 400-kw, direct-connected Crocker-Wheeler railway generator; two 100-kw belt-driven, T.-H. railway generators; two 120-kw, belt-driven, 133-cycle, single-phase T.-H. alternators, one 75-kw alternator of the same make and frequency, and six T.-H. arc machines. It is expected that the new station will be in regular operation shortly, the machinery being now under test. In a later article we hope to take up the operating features of the plant, the transmission circuits and the business-getting methods to be adopted. The engineers for the plant are Messrs. J. G. White & Co.

Engineering Features of the New Altman Department Store Building, New York.

THE new Altman building was designed to be one of the highest class located on Fifth Avenue, New York. The business is solely one of dry goods; that is, silks, cloths, rugs, draperies, gloves and other articles of wearing apparel. No furniture is sold, except small fine pieces and no household utensils. The building covers a plot approximately 200 by 300 ft. and is eight stories high, with a basement extending over the whole area and a sub-cellar extending over about one-half the area. The building is located on the east side of Fifth Avenue at Thirty-fourth and Thirty-fifth Streets. The total cubic contents of the building is approximately 8,250,000 cu. ft., deducting all court area. The total floor area, including basement and sub-basement, is 520,000 sq. ft. and the total area contained in the customers' floors, which are the ground floor, second, third and fourth floors, is 210,000 sq. ft.

The store is designed with a large central court or rotunda covered over at the fifth floor by an ornamental glass dome and again covered at the top of the building by a skylight. There is a great deal of glass surface and exposed wall surface, the windows coming down to within 2 ft. of the floor and occupying a large proportion of the walls.

The elevator equipment includes 13 main passenger elevators, 2 special elevators, 4 freight and service elevators and one sidewalk elevator, all of the hydraulic plunger type; and three electric dumb waiters. There are 1,450 arc lamps and circuits have been run for 8,136 16-cp incandescent lamps. There are 600 hp of motors installed for driving fans, blowers for the pneumatic cash system, sewing machines, pumps, etc. Electricity is also supplied for heating irons, glue pots and other utensils. There are 2,000 floor outlets provided for various purposes.

The power plant consists of eight Stirling water-tube boilers having a rated capacity of 2,100 hp; five direct-connected Ball-Wood four-valve engines driving 115-volt General Electric generators, three having a capacity of 500 kw for two hours, or 400 kw continuously, and the two smaller sets having a capacity of 250 kw each for two hours, or 200 kw continuously. A careful estimate of the cost of operation of the plant shows the manufacturing cost per kw-hour to be approximately 8/10 cent and the fixed charges 7/10 cent. The fixed charges include interest on the cost of engines, dynamos, switchboard, wiring connections to generators, high-pressure steam fitting connections to engines, additional boiler plant required, and extra excavation and preparation of engine room; depreciation at 5 per cent on the cost of the plant and 3 per cent on the cost of the rest of the apparatus. The total cost per kw-hour is estimated not to exceed 1½ cent, including all items. The boilers are designed to burn No. 3 buckwheat coal under natural draft and the ratio of grate surface to heating surface is made large on this account.

The lighting of the large spaces of the store is done by General Electric enclosed arc lamps fitted with specially designed outer cases and French globes, and consuming 6.5 amp. instead of the usual 5 amp. This gives a high temperature in the crater resulting in a brilliant white light free from purple or violet rays, which are objectionable in department store work where color values are of great importance. Arc lamps were determined upon in preference to Nernst or incandescent lamps because of their lower cost of maintenance and more perfect color values. Incandescent lamps in Frink reflectors are used throughout for window and showcase lighting and in what are termed the "evening" rooms. In the latter rooms and in the showcases the lamps are placed behind ground glass.

A special feature of the lighting is that of the rotunda. The lighting of this dome is entirely by concealed lamps, and it is necessary to light not only the underside of the dome, but to have the light shine through as well, in order to show the design and delicate tracery. This has been accomplished by a large series of reflectors suspended about 30 ft. above the center of the dome containing lamps giving a total of 4,000 cp; and an equal quantity of light is supplied around the base of the dome by incandescent lamps in Frink reflectors. The result is a beautiful golden glow over the whole dome, and every detail is distinct.

The probable load curve of this building will be about as follows: During the winter months from 8 a.m. to 5 p.m., 750 to 900 kw; from 5 p.m. to 6.15 p.m., 900 to 1,100 kw; from 6.15 p.m. to 7 p.m., 350 to 400 kw, and from 7 p.m. until 8 the next morning the load will vary from 125 to 300 kw. In the summer the maximum load will probably not exceed 750 kw. The total kw-hours per year used for lamps and motors will approximate 2,250,000.

Electricity is used to wind and set the clocks located all over the store; to provide heat for pressing and smoothing irons, glue pots and other utensils; to transmit fire alarms to city and local fire departments; to light the numerous automatic gas burners placed throughout the store as a precaution in case of accident to machinery; to run the dumb waiters and one elevator; to drive the heating and ventilating fans and to supply motors from a 1/10-hp individual motor on sewing machines to the 100-hp motors on the cash blowers. The electric heating installation for irons is particularly extensive, and the quantity of electricity required for this purpose alone is equivalent to that required for 1,600 16-cp lamps. The motors are divided as follows: 250 hp in fans, 200 hp in cash blowers, 150 hp in pumps, elevator, escalators, conveyors, sewing machines, etc.

The wiring system is for 110 volts, two-wire, this voltage being chosen on account of the arc lamps. The two-wire system was chosen after careful estimates had been made on the cost of the feeder system, switchboard, generators with the three-wire, 240-volt system; and it was found that the saving in feeders was more than balanced by the extra cost of switches, instruments and circuit-breakers for the switchboard and the extra cost of the generating plant; besides the increased complication and the increased liability to shut down or burning out of lamps through blow-out of fuses on one side of the three-wire system or in the neutral.

The lighting feeders were figured for a 3-volt drop, and it was found with a 2-volt drop the interest on the extra cost of feeders more than balanced the cost of producing the extra volt, and the load on each feeder was sufficiently constant to make the actual variation in voltage at the lamps at different periods of the day not over 1½ volts. The feeders from the switchboard to the panelboards are supported where they leave the conduit to enter the fuses on panels by lignum-vitæ supports which take the weight of the feeders off the panel.

There are six panelboards on each floor. These panels contain enclosed fuses connected by direct copper connection with push button switches. Each panel is connected by a separate feeder to the main switchboard in the engine room, the smaller feeder being No. 0000 wire, and the largest 400,000 cir. mils. The feeders are carried down into the engine room to a level with the top of the switchboard and thence straight across to specially designed slate panels set at right angles to the board. On each side of these slate panels are mounted fuses and copper connections running up to the feeders. This arrangement avoids any possibility of short-circuit between positive and negative fuses or connections, and does away with any wire back of the board. It also allows ready replacing of fuses without danger of shock or short-circuit. No circuit-breakers are used at all on the switchboard or anywhere throughout the building, except on the small storage battery installation.

The switchboard is made of white marble with black marble cornice and contains 12 panels. An ammeter is provided for each machine and a voltmeter and a potential indicator are mounted at each end of the board on swinging brackets. In addition there is a totalizing panel containing an ammeter showing the total current, a ground detector voltmeter and watt-hour meters arranged so that the shunts may be calibrated at any time, and curve drawing instruments showing the variation of voltage and current. The main dynamo leads come up under the floor directly into vertical lugs; these lugs are directly connected to fuses placed at an angle, the other end of the fuses being bolted on to the studs of the dynamo switches. Slate barriers are placed around each fuse so as to prevent the blowing of one fuse from affecting the others. A feature of the wiring is that there is not a sweated joint throughout the building, Dossert connectors being used exclusively. By this means a wrench and screwdriver are all the tools required to take any wires apart.

The bells and electric gas lighting system are supplied with electricity from a duplicate storage battery. The storage battery

is charged by a duplicate Holtzer-Cabot motor-generator set. There is a low-voltage switchboard controlling the electric gas lighting system, fire alarm signals, self-winding clock circuit, closing down gongs and watchman's clock. This board operates with current at 10 and 20 volts and contains a separate switch for each riser, and a double-throw switch arranged to connect one motor-generator set with one of the storage batteries and at the same time to throw the other battery on the discharge. An ammeter and a voltmeter are also provided. The board is finished in a manner similar to the main switchboard. The 48 electric annunciators are equipped with electrical reset operated by storage battery current. The annunciators are placed at some height from the floor and the drops are reset by push button control. Errand boys cannot, therefore, tamper with the annunciator or reset it with such a bang as to render the device useless. The emergency system of gas lighting on each floor is controlled from two points where push buttons are provided, one for igniting the gas and the other for turning it off. When a button is pushed, clock-work mechanism causes an arm to make wipe contacts with all the contacts, thereby turning on the gas and lighting the 25 burners provided to a floor.

All the wiring is run in conduit, including all connections to bells, telephones, etc. In many cases to economize in labor and conduit, two circuits were run in one conduit from the panelboard, the conduit being increased in size. Mr. Percival Robert Moses was the consulting engineer for the installation and the C. L. Eidlitz Company were the wiring contractors.

Electrical Exhibits and Demonstrations in Wanamaker's New York Store.

In the basement of the Wanamaker store at Broadway, Fourth Avenue, Eighth, Ninth and Tenth Streets, New York, has been installed a model electrical apartment to demonstrate to patrons the operation and use of practically all the electrical devices that have been introduced for utilizing electricity in the home. Two rooms, a kitchen and bedroom, are fitted up as shown in the accompanying engravings and have attracted very much interest. The electricity is supplied from the large isolated plant installed in the sub-cellar, a description of which was published in the March 31 issue.

The general arrangement of the apparatus in the bedroom and kitchen is shown in Fig. 1, while the space devoted to the sale and exhibition of electrical devices in the Wanamaker store is shown in Fig. 2. The reference letters in the model kitchen have the following significance: *A* is an electric range including oven; *B* is an electric refrigerator plant; *C* is an electric coffee or hot water urn; *D* is a kitchen closet with electric plate warmer below; *E* is an electrically-driven coffee grinder; *F* is an electrically-driven meat chopper; *G* is an electrically-driven silver polisher; *H* is a washing machine and wringer, both electrically driven; *I* is a sink with electrically-heated dish pan; *J* is a table with a complete electrical ironing outfit; *K* is an electric exhaust fan; *L*, interior and outside telephones; *M*, annunciator, and *N*, a burglar alarm in the window frame.

In the model bedroom the letters have the following significance: *A* is a bed; *B* is an electric heating pad; *C* is a Hylo lamp and combination socket for connecting the heating pad in the circuit; *E* is a call button; *F* is a table holding an electrically-lighted clock, night lamp, electric torch, desk telephone and electric fan; *G* is a closet lighted when the door is opened; *H* is a luminous electric radiator; *I* is a dresser wired for two side lamps; *J* is a curling iron heater; *K* is an electric foot warmer; *L* is an electric hair drier; *M* represents interior and outside telephones; *N* is a wash basin; *O*, a shaving mirror wired for two lamps; *P* is a table holding a medical battery outfit, milk warmer and sterilizer, shaving cup and massage machine; *Q* is an electric carpet sweeper; *R* is a space which may be screened for a sewing-room or cosy corner; *S* is an electrically-driven sewing machine; *T* is a table for sewing-room iron, fan, portable lamp and cigar lighter; *U* is a table wired for a chafing dish and percolator; *V* is a closet on the wall for dishes, etc.; *X* is a switch for controlling the lamps in space *R*; *Y* is a switch for controlling the lamps in the bedroom, and *Z* is a burglar alarm in the window casing.

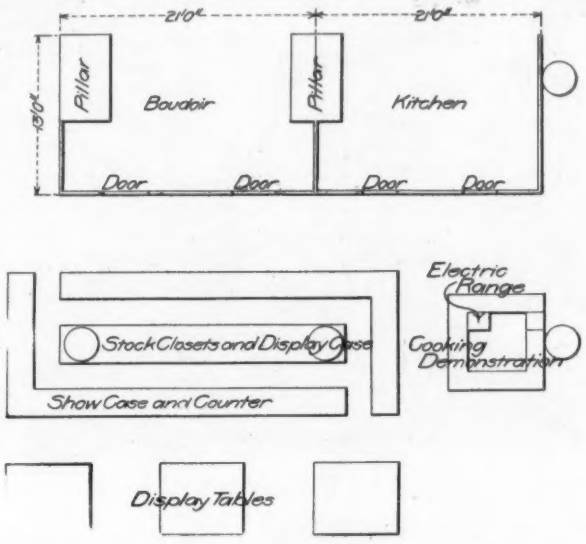


FIG. 2.—PLAN VIEW OF ELECTRICAL EXHIBIT AT WANAMAKER'S NEW YORK STORE.

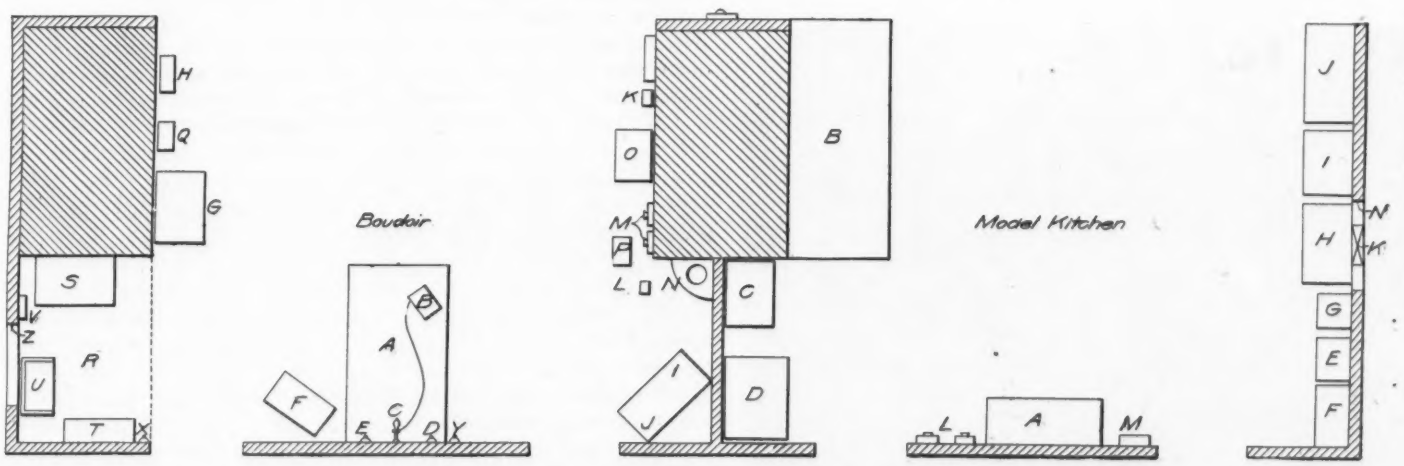


FIG. 1.—PLAN VIEW OF BOUDOIR AND KITCHEN AT WANAMAKER'S NEW YORK STORE.

While it is not expected that every room will be as elaborately equipped with electrical devices as the rooms at Wanamaker's, the purpose is to show what can be done in this direction. While the department store reaps an advantage from such an exhibition and demonstration in the profit on the articles sold, central stations also reap a benefit because each article consumes electricity. Herein is an advantage which every central station in

towns or cities having large department stores should avail themselves of. Domestic electricity is attracting marked attention and electricity is destined to become a general household utility rather than a luxury as many now seem to think it is. When

FIG. 3.—MODEL KITCHEN AT WANAMAKER'S NEW YORK STORE.

the cleanliness, safety and convenience of the foregoing applications of electricity are taken into account, cost is of minor consideration. The almost universal impression is that the cost of

Article.	Average watt hour consumption.	Period of operation.	Cost during that period at 10 cts. per K.W.H.
Chafing dish	400	20 minutes	$.01⅓
Pint baby milk warmer and food heater	250	6 "	.00¼
Quart food heater	500	6 "	.00½
Coffee percolator	300	20 "	.01
Stove, 6 inch	500	15 "	.01¼
Stove, 8 inch	800	15 "	.02
Broiler, 9x12 inch	1200	15 "	.03
Curling iron heater	60	15 "	.00⅜
Heating pad	50	per hr.	.00½
Iron, 3½ lb.	250	30 minutes	.01¼
Iron, 6 lb.	500	30 "	.02½
Frying pan (7 in. diam.)	500	30 "	.02½
Waffle iron	500	12 "	.01
Tea kettle	300	20 "	.01
Glue pot, 1 quart	300	20 "	.01
Soldering iron, 2 lb.	200	30 "	.01
Doctor's sterilizer	1000	30 "	.05
Bath room radiator	1000	30 "	.05

operating these various electrical devices is prohibitive; and little seems to have been done to eradicate this impression. Since

FIG. 4.—BOUDOIR AT WANAMAKER'S NEW YORK STORE.

the devices are only used for a very short space of time, the actual cost of the electrical energy consumed is but slight as is evidenced in the accompanying table, which gives in convenient form the average consumption, period of operation and cost of operation during that period with energy at 10 cents per kw-hour for the various devices enumerated.

Another advantage of electrical exhibits in department stores rests in the fact that the electric light companies are not in such close touch with the buying public, and especially the women, as is the department store. The latter would advertise the exhibit as one of the features of its store, and even if it did not the thousands who visit department stores cannot fail to see it. It seldom pays to talk electric heating; demonstrating is what counts, and the natural inquisitiveness of the human race can always be counted on to lead one to a demonstration going on. At Wanamaker's a demonstrator is kept constantly at work cooking different dishes. Daily menu cards of what is prepared are distributed and these have printed instructions for making the various dishes prepared at the demonstration. On the back of the menu cards are advertisements of various electrical devices. The menu cards and the advertisements on the back of them are changed daily, and it has been found that women take these cards home for the sake of the recipes printed on them. The space on the back of the cards is, therefore, valuable for advertising the devices.

The accompanying engraving is a reproduction of one of the Wanamaker advertisements of the exhibit. Following the invitation to visit the exhibit is a list of various devices and the price of each. The articles on sale include the following: Electrical kitchen ranges, plate warmers, ovens, chafing dishes, coffee percolators, tea kettles, portable stoves, broilers, griddle or toaster, water heaters, nursery milk warmers, coffee urns, immersion coil heaters, heating pads, curling iron heaters, cigar lighters, glue pots, soldering irons, sealing wax heaters, instrument sterilizers, traveler's irons, sewing-room irons, laundry, factory and tailor's irons, radiators, foot warmers, fans, coffee grinders, meat and vegetable choppers, buffer, polisher and grinder, combination clothes washer and wringer, massage vibrators, hair driers, electric sewing machines, carpet sweepers, ventilating fans and refrigerator plants. In battery goods there are telephones, medical batteries, massage vibrators, pocket flash lamps, watchmen's lanterns, house lamps, surgical and dental lamps, book lamps, watch stands with cords and press button, clocks, candles, banquet lamps, ruby lamps for photographers, reading lamps, cigar lighters, gas and range lighters, etc. A full line of electrical supplies such as buttons, wires, sockets, plugs, etc., is also carried. Everywhere plugs are provided so that a demonstration may be instantly given and well-trained employes are in charge.

The Electric Home

Exhibition and Demonstration of Domestic Electricity

We have installed in the Basement of our new building one of the most interesting exhibitions that housekeepers and home builders have ever seen. Electrical inventors have accomplished wonders in recent years, and a special energy has been applied to the development of electrical devices for use in the home.

To-day there is scarcely a hand's-turn for which electricity does not provide a help.

An electric range does all sorts of cooking in the most prompt and perfect manner, an electric coil heats water right in the dish pan; an electric refrigerating plant—taking no more space than a large refrigerator—provides the most perfect cold storage and freezes a supply of ice for other uses besides. There are electric meat choppers, knife sharpeners and polishers, coffee grinders, electric washing machines and wringers. There are countless other devices for the bedrooms, hall, bathroom. There are electric heaters, chafing dishes, cigar lighters, alarm clocks and warming pads.

In our model electrical apartment we show all these devices in active operation. Housekeepers will be amazed to learn how little it will cost to instal many of these helps in their home, as well as to operate them afterward.

We invite you to come and see the exhibition.

Criticism has heretofore been made regarding the electrical devices on sale in department stores that while a central station company could not only sell but install the device and at the same time guarantee it, such was not the case with the depart-

FIG. 5.—GENERAL VIEW OF ELECTRIC DISPLAY.

ment store. The Wanamaker store is now considering to do the actual installing of the devices and to stand back of the installation. This, however, is not essential. Department stores sell gas ranges and offer to connect them, supplying the necessary gas pipes, etc. The actual work is done by the local gas company. There seems to be no reason why central stations could not come to some such working agreement with department stores also.

Electroliers and lamps with art glass shades form an interesting exhibit in themselves and a large space is allotted to these on another floor in the building. The exhibit which will last for the rest of the year was gotten up for the Wanamaker store by Mr. Max Loewenthal. A Moore vacuum tube encircles the entire space and is a feature of the exhibit.

Central Station Work in Vermont.

IMPROVEMENT IN CENTRAL STATION WORK AT BURLINGTON, VT.

The Burlington Light and Power Company, of Vermont, serves a population of about 26,000 people, and in its equipment and methods is one of the most progressive central station organizations in the Green Mountain State. The power plant of the company at Winooski was described in these columns January 24, 1903, but since that time a number of important improvements have been effected in the generating system and equipment. The business methods of the company are in close touch with the latest ideas as to seeking revenue instead of waiting for it to come of its own accord.

In 1902 the Burlington Gas Light Company and the Consolidated Electric Company were merged in the present organization, which was further strengthened in 1904 by the acquisition of the Vermont Electric Company. The officers are: President and treasurer, Morris W. Stroud, Philadelphia; general manager and purchasing agent, S. P. Curtis, Philadelphia; secretary and local manager, F. H. Parker, Burlington. The company has comparatively recently occupied a new office building in the business district of Burlington, which is one of the most attractive structures of the kind in the country. Fig. 1 is an exterior view of the building, which is a three-story and basement brick structure devoted exclusively to the lighting, gas and power business. On the street front are two large plate glass display windows and the entrance is imposing and convenient. The interior is finished in North Carolina pine stained brown in the general offices and green in the local manager's private office. The finish and appearance of the general offices are shown in Fig. 2, the general effect resembling a high-class banking institution. Attractiveness to the public was considered well worth securing in the construction of the office building, and the architectural effect is that of permanence, and substantial beauty of design.

The basement is commodious and provides for the storage of wire, cross-arms in an adjoining shed, line material and miscellaneous supplies, besides housing a machine shop with motor-driven lathe, gas pipe racks, and a local electrical distributing switchboard for the building. All goods are received by a

FIG. 1.—VIEW OF OFFICE BUILDING.

stock clerk who keeps a record of them in a card catalogue. An electric freight elevator serves the different floors. The street floor contains the general offices, the manager's office, lavatory facilities and a handsome lamp display room where customers are taken to pick out different styles of lamps and shades. Working exhibits are made in this room. On the second floor is a stock room for gas burners, a meter laboratory and an office for the company's solicitors. The meter laboratory is equipped with the latest testing instruments, a 50-lamp bank resistance, light tools and supplies. It is provided with excellent natural as well as artificial light, is roomy, comfortable and free from vibration.

At the time of the previous article in the ELECTRICAL WORLD AND ENGINEER, the power house at Winooski contained 2,200 hp in turbines, 900 kw in electric generators, four 65-light series

FIG. 2.—VIEW OF GENERAL OFFICES.

arc dynamos, a 45-light and a 55-light arc machine. The plant now has a capacity of about 2,000 kw in generating machinery, and the old layout has been greatly improved by the additional power provided, by the strengthening of the foundations of

the building and replacement of the old wooden flumes by 5/8-in. steel pipes 10 ft. in diameter, and by the more flexible arrangement of the equipment.

The Winooski plant is one of the most peculiar in the country with respect to its hydraulic features. The power house is built on solid rock, the north wall of the building constituting part of the forebay. The building is 110 ft. long, 60 ft. wide, and it extends entirely across a deep gorge of the Winooski to a small island in the river which also serves as the terminus of a crib dam which gives an available head of 33 ft. on the water wheels. The present wheels consist of one Hercules, two Hunts and a Victor turbine aggregating 3,100 hp. All the wheels are in the power-house basement and are belted to a line shaft 110 ft. long and 9 in. in diameter, which makes 225 r.p.m. About 50 per cent of the station capacity is direct coupled to the line shaft, whereas all the original machines were belted to the shaft by pulleys. The present generating apparatus consists of two 32-pole, 500-kw, 2,300-volt revolving-field G. E. three-phase alternators direct-coupled to the shaft; a 200-kw belted and a 225-kw belted Westinghouse, and a 500-kw belted G. E. alternator, all 2,300-volt, 60-cycle machines. Seven clutches are provided in the line shaft for cutting in and out different machines. The arrangement is far more flexible than in the original station, and is more efficient. A Brush arc machine is also driven from the line shaft, and in case of low water a 500-hp McIntosh & Seymour engine is available at one of the line shaft pulleys. Four boilers are maintained in the plant for this service, but the water supply is sufficient for the needs of the system at practically all times. The engine has not been operated for two or three years.

The wheels are controlled by Lombard and Schenck governors. At the time the improvements were made the old flood-gate arches were filled in with 36-in. cast iron pipe and cemented, the flood gates being relocated at the end of the pipes. The exciters are all belt-driven from the line shaft. The switchboard contains nine panels, two of which are devoted to exciter service, three to the 500-kw generators, two to the 200 and 225-kw alternators, and two to feeder service. The company lights the military reservation at Fort Ethan Allen, and the two Westinghouse machines are used for that purpose.

From the Winooski plant one three-phase, 2,300-volt line runs to Fort Ethan Allen, which is about two miles distant; a 30-light arc circuit traverses Winooski Village, and two No. 0 three-phase lines run to Burlington, which is 3.5 miles distant. One of these lines is reinforced by a No. 0 conductor in parallel with each phase. This circuit is devoted to the power load, the other carrying the lighting business. There are no sub-stations in the company's service, all the power and lighting being controlled from the generating plant alone. The General Electric alternators are operated in multiple, and the Westinghouse machines are also paralleled, but the two makes are kept separate. Watt-hour meters are used on each outgoing circuit. The hours of the shifts at the power house are twelve each.

The lighting rates of the company were formerly 12 cents per kw-hour for residence service. These have been reduced, and are now from 6.5 to 15 cents. Power rates were formerly from 3.33 to 5.5 cents; they are now as follows:

5 cts. per kw-hour for the first 200 kw-hours per month.
4.5 cts. per kw-hour for the second 200 kw-hours per month.
4 cts. per kw-hour for the third 200-kw-hours per month.
3 cts. per kw-hour for the fourth 200 kw-hours per month.
2.75 cts. per kw-hour for over 800 kw-hours per month.

No monthly bill is rendered for less than $1.00. The largest motor allowed on lighting circuits is 5 hp, and the company prefers to have motors on power lines only. The company uses both chestnut and cedar poles. No creosoting is done by the company. The cedars are 40 ft. long and cost about $7 each delivered at the company's yard. Their life on this system is from 12 to 15 years. The chestnut poles last from 9 to 12 years. Inside wiring is done by local contractors. The company will make any reasonable connection to remote customers. The superintendent, construction foreman, station and trouble men are supplied with free telephone service. The company does not do much newspaper advertising, but the public is encouraged to inspect its plant. News items are given the papers freely. An electric sign is now being made for the company's use. Graphitized filament lamps are being tried in service, and in the business departments an extensive use is made of the card catalogue. The company's solicitors are in active service all the time. Circulars are frequently sent to customers with bills.

The municipal lighting at Burlington is handled by the city, which attempts to compete with the water-power plant by running a costly steam station located on the edge of Lake Champlain. The Burlington Light and Power Company meets the municipal scheme by giving a superior quality of service to its customers.

CENTRAL STATION WORK AT MONTPELIER, VT.

Considerable progress in power station improvement and in the pushing of new business is now being made by the Consolidated Lighting Company of Montpelier, Vermont. This company began operation in 1896 as a consolidation of the Montpelier Gas Company and the Standard Light & Power Company, the last named company having been in business since 1885. The territory served consists of the cities of Montpelier, Barre, East Barre, Graniteville and Williamstown, the aggregate tributary population being 26,000. The officers of the present organization are: President, W. F. Davidson, of Port Huron, Mich.; vice-president, John C. Tomlinson, New York; treasurer, A. D. Bennett, Port Huron; manager, Jas. E. Davidson, Montpelier, and superintendent, E. O. Wedge, Montpelier.

The company now has two power plants in service. One is located at Bolton Falls, on the Winooski River, 17 miles from Montpelier, while the other is in the outskirts of Montpelier itself. The Bolton Falls plant is a hydro-electric station, containing two 450-kw, General Electric 12,000-volt, three-phase generators driven by two 1,000-hp Holyoke turbines, and a 1,200-kw General Electric alternator driven by a 2,200-hp Allis-Chalmers wheel. The Montpelier plant is the centre of distribution of the system, and it contains an outfit of Stirling water-tube boilers, a 3,000-hp McIntosh & Seymour engine direct-connected to a 2,500-kw General Electric alternator, and a 1,500-hp Warren steam turbo-alternator. This plant also contains a 150-kw, 600-volt motor generator set of the belted type which supplies current to the Barre & Montpelier Street Railway.

The Bolton Falls plant is connected with the Montpelier station by two three-phase, 12,000-volt circuits of No. 4 wire, and one of No. 1 wire. A tap is taken off the No. 1 line to Waterbury before the circuit reaches Montpelier. The distribution of high-tension power from Montpelier to Barre is carried out over an 8-mile line, three-phase No. 1 copper over a private right of way. From Montpelier to Graniteville, 11 miles, a three-phase, No. 0 circuit is run. The poles of these lines are of cedar. The steam plant at Montpelier runs 8 hours per day ordinarily, the balance of the load being carried by the water power plant. Coal costs about $6.50 per ton at the granite quarries in the neighborhood.

At Montpelier are three 100-kw, air-cooled step-down transformers for local service. All sub-stations distribute locally by three-phase, 2,300-volt, 60-cycle current. The street railway load is handled by two 100-kw transformers, and the street lighting work by two 75-light tub transformers. Barre has a population of about 15,000, and the sub-station equipment here is composed of three 200-kw General Electric transformers, two 200-kw Westinghouse transformers and two 75 light 6.6 ampere tubs. The wiring of the Barre sub-station is laid out with liberal provision for safe operation, the maximum spacing between conductors being about 4 ft., with a minimum of 2 ft. in the 12,000-volt side. Waterbury, with a population of 2,500, carries two 75-kw transformers for local distribution. Williamstown is fed from the Graniteville sub-station.

All the incandescent lamps on the system are 104-volt units, and power is handled by 230-volt, three-phase motors. A few single-phase motors are in service. The company has a large motor load in proportion to the population of the territory. About 1,700 hp in connected water load is now on the com-

pany's mains, or 1 hp to every 15.3 inhabitants. The water power electric supply has been a most fortunate development for the community. The present power rates are 2 cents per kw-hour for over 20 hp connected load in Montpelier and Barre, with a minimum of $1 per month per hp installed. The rate is 2.8 cents in the quarries at Graniteville and Barre. The residence lighting rate all over the system is 10 cts. per kw-hour, commercial lighting being supplied at 6.6 cents in Montpelier and Barre. The company has had wide success in the introduction of electric flatirons, an illuminated sign on the front of the office in the Lawrence block being used to advertise the 30 days' free trial which is given. There is no conduit construction in the company's territory. The street lighting circuits are patrolled at night, and the superintendent and engineer are furnished with free telephone service by the company.

All the house transformers are type H General Electric units, and no air-cooled transformers are in service. Three-wire secondary distribution is used, and in general, efforts are constantly being made to improve the physical condition of the equipment. No motors are allowed on lighting circuits. Some of the company's customers are farmers, who use electric lights and small motors for operating cream separators and ensilage cutters. The public is encouraged to visit the power stations, and the organized solicitation of new business is practiced. Weekly advertisements are placed in the local press, and these are frequently changed for the sake of variety. The local papers are also freely supplied with news items. The company charges its customers cost price, or 15 cents for new incandescent lamps. There is little trouble with the isolated plant competition, and the high gas rate of $1.60 is effectively met with Nernst lamps. There are about 150 two and three-glow Nernsts on the system. The operation of the system is carefully analyzed by the management at regular intervals on a thoroughly scientific basis.

CENTRAL STATION PRACTICE AT ST. JOHNSBURY, VT.

Two essentially modern features characterize central station practice at St. Johnsbury, Vermont, a thriving town of 7,000 inhabitants located in the northeastern part of the Green Mountain state. The first is the use of electrically-transmitted water power from plants located within a few miles of the business center of the community; and the second is the sale of alternating current alone in the company's commercial service. Under the energetic leadership of Col. T. C. Fletcher, president, and Manager E. E. Gage, the St. Johnsbury Electric Company, organized in 1888, has steadily responded to the progress of electric lighting and power applications and has given the community a service which compares favorably with that available in many a city of larger size.

Three small generating plants supply the current for the company's service. One is located about 1.5 miles from the city, a second 3 miles, and the third is also 3 miles distant. The first two plants have a capacity of 400 kw and 125 kw, respectively, and need not be described in detail, as they do not represent the advance in practice that plant No. 3 does. This last named plant has a capacity of but 240 kw, but it is a typically modern installation. Plant No. 1 contains a number of belted steam engines of the non-condensing type which operate in conjunction with the water wheels at times of heavy load. Both plants Nos. 1 and 3 are located on the Passumpsic River. All the transmission is at 2,300 volts, three-phase.

The power house known as No. 3, which has recently been completed, is a concrete building 53 ft. 9 in. long by 29 ft. 7 in. wide. From a forebay located at the north side of the building a 7-ft. diameter penstock leads into the station to a 400-hp New American horizontal turbine made by the Globe Iron Works of Dayton, Ohio. Direct-connected to the turbine is a 36-pole, 240-kw, 60-cycle, 2,300-volt, three-phase revolving field General Electric alternator whose speed is 200 r.p.m. The turbine operates under a head of 22 ft. Belted to the alternator shaft is a 4-pole, 11-kw, 125-volt exciter making 850 r.p.m. The switchboard is a two-panel outfit of blue Vermont marble carrying a Tirrell voltage regulator, edgewise ammeters and voltmeters, an oil switch for the alternator, the usual rheostats and exciter connections. The alternator in station No. 3 is run regularly in multiple with the alternators at station No. 1 which are of the Stanley inductor type. Governing at station No. 3 is at present taken care of by hand regulation operated by the attendant in charge of the station. The floor of the plant is a reinforced concrete structure, and there is a gallery 13 ft. 6 in. above the floor used for storage and a small shop. The station is heated in the winter by a Pierce steam heater. The load at the plant varies from 200 to 400 hp, and the water supply enables service to be given about eight months in the year from this station.

The present connected load of the system consists of 103 alternating-current multiple arc lamps, 85 series direct-current street arcs, about 16,000 equivalent 16-cp lamps and 360 hp in motors. About 135 hp in motors are operated by the company in the works of the Fairbanks Scale Company, and a large electric oil heater for raising the temperature of fuel oil for forges to 180° is in service here. This device consumes 54 amperes at 220 volts. The largest single-phase motor on any lighting circuit is 5 hp. A grist mill served by the company has a connected load of 95 hp, and there are several farmers on the company's lines who use electric lights, and ensilage and feed cutters operated by small motors.

The rates of the company are 10 cents per kw-hour for lighting and from 6 to 3 cents for motors. On the lighting circuits a 10 per cent discount is given upon a bill of $10 per month, and 15 per cent on a $20 monthly bill. Between 5 a. m. and 5 p. m. a lighting and heating rate of 5 cents per kw-hour is charged, two-rate meters being installed. Inside wiring is done by the company practically at cost. Personal solicitation of new business is practiced, but elaborate methods of securing it are not in vogue. The officers of the company besides the already named are: Vice-president, H. Paddock, of St. Johnsbury; secretary and treasurer, J. C. Clark.

Central Station Notes from Lincoln, Neb.

Lincoln, Neb., is an interesting city to the central station man because of the unusual development of sign, outline, and display lighting on the down-town streets. It is doubtful whether any other city in the United States of its size has such an amount of this class of lighting. The population of Lincoln was 40,169 in 1900 and is doubtless now 10,000 or more larger. The amount of sign and display lighting carried by the Lincoln Gas & Electric Light Company is between fourteen and fifteen thousand lamps. Nearly all of this display lighting is in 4 and 8-cp lamps taken on a flat rate, as is the practice in the other American Light & Traction Company plants over the country. They are turned on and off by the company's patrolmen and the rate is based on the "readiness-to-serve" method of charging. There is considerable outlining of buildings, as this was the first display business to be worked up. At present the electric sign business is being pushed most actively.

WHITE BACKGROUNDS FOR WINDOWS.

Excellent window displays by merchants are very common. A noticeable feature of window displays in this town is the light colored ceilings and backgrounds for the majority of window displays. The company's solicitors have thoroughly impressed the merchants with the importance of light trimmings, backgrounds, and ceilings if window displays are to be made to stand out prominently at night. It is very common to see decorated plaster ceilings to a display window, these ceilings usually sloping from front to back of windows so as to aid in lighting the window display by reflection. Such light ceilings and backgrounds would cost considerable to maintain in a large city where soft coal burning is common, but in a town the size of Lincoln the results seem to be excellent.

CHANGED RATIO OF OUTPUT TO PEAK LOAD.

A fact which should be of great interest to central station managers in connection with what has been accomplished at Lincoln is that the load and output curves for August, 1906, and August, 1905, show that the August, 1906, peak loads were about 40 per cent higher than those of August, 1905, while the increase in output was about 80 per cent. In other words, the earning capacity of the plant is increasing faster than the

investment needed to carry peak loads, which is the condition toward which all thoughtful central station managers are striving. This change in ratio between the peak and the output is due largely to the increase in the number of flat-rate sign and display lighting contracts and in power contracts. These flat rate sign contracts insure a steady fixed load a certain number of hours every evening. The peak load Saturday, September 8, 1906, was 930 kilowatts, which is about 25 per cent higher than the peak load of December, 1905. The load during the same day, except at noon, was about 400 kilowatts. The electric business is increasing much faster than the gas business, and this in spite of the fact that the readiness-to-serve rate is enforced in the residence districts, instead of being optional as it is in most cities where this rate system is used. As applied to residences in Lincoln the minimum is $1.75 per month, of which $1 is service charge and 75 cents is the readiness-to-serve charge at a rate of 15 cents each for five lamps. The other lamps in the installation are not counted. In the down-town districts all lamps in an installation are counted.

NON-PEAK CONTRACTS.

The company recently took a contract covering an installation of 80 hp in motors at a low rate; a clause being in the contract providing that the company can cut off service during the company's peak load. This installation is near the station, and being supplied by a separate feeder, this contract can be enforced by the opening of a switch at the station if necessary.

POLICY TOWARD HIGH EFFICIENCY LAMPS.

Nernst lamps are being introduced. They are sold outright to the customer, but the company maintains them free of charge.

SOLICITING FORCE.

As many as seven men have been employed as solicitors in the new business department. This is for both gas and electric business. Recently there has been difficulty in keeping the soliciting force up to this number, because of the impossibility of getting experienced men.

The company is under the management of Mr. Homer Honeywell. The electrical department is at present under Mr. B. C. Adams, superintendent, and Mr. T. B. Mitchell is manager of the commercial department.

Conditions of Lighting at Rochester, N. Y.

An interesting report has been made by Mr. E. A. Fisher, city engineer of Rochester, N. Y., in favor of the new contract with the Rochester Railway & Light Company, as compared with the service that the city could have given itself from a municipal plant. The following is a summary of the bid:

(A)	500 arc lamps connected with the underground circuit, located singly, at $68 per year	$34,000.00
(B)	500 arc lamps connected with the underground circuit, located in pairs, at $62.96 per year	31,480.00
(C)	2,600 arc lamps connected with overhead wires, at $57.95 per year	150,670.00
		$216,150.00
(D)	200 32 candle power incandescent lamps at $19.34 per year.	3,868.00
	Total	$220,018.00

As compared with the old prices this shows a saving of $302,525 for the five-year period.

Mr. Fisher discusses in his report the data of a number of municipal plants in operation or proposed, and gives special attention to the designs prepared, but since abandoned, for New York City. He shows that Rochester could not equal for itself the private figures offered and says:

The cost of operating and maintaining an electric lamp is made up of several items, among which may be mentioned the cost of electric power, the maintenance of the lamps, poles and other fixtures, together with a suitable allowance for the depreciation of the plant and the interest and taxes on the investment.

The gross power required to operate an arc lamp, if delivered at the high voltage necessary for long-distance transmission lines, is very nearly equivalent to one horse-power per lamp. Assuming the lowest probable cost for power delivered at the city line and making proper allowances for the other enumerated items to cost, we find, by careful estimates, that the cost under these conditions would probably exceed the price bid by the Rochester Railway & Light Company.

The Railway & Light Company operates several power stations within the city. These stations are so connected that in the event of the failure of one station the load would be carried by the others without interruption of the service. Electric energy generated and delivered in this manner is certainly less liable to interruption than a long exposed line from a single source.

For the foregoing reasons it is not advisable, under present conditions, to purchase electric power at the city line.

In comparing the price bid by the Rochester Railway & Light Company with the prices quoted of the cost of lighting in other cities, it should be borne in mind that the prices in other cities are those generally prevailing at the present time. It is probable that when new contracts are made considerable reductions will be made in some of these costs. The fact remains, however, that the price named by the Rochester Railway & Light Company is very much below that of the recent contracts made in those cities that can be compared with this city. The price also is as low, or lower, than the cost in large cities having municipal plants, when proper allowance is made for interest, taxes and depreciation.

I believe that the price named by the Rochester Railway & Light Company is lower than we can expect to get in any other way. The lamps now in use are the same kind of lamp as was proposed by the eminent commission appointed by the mayor of the City of New York for a municipal plant. The specifications are fully as strict in their requirements as those of any other city, and I would say in conclusion that after the most careful investigation of the lighting question, extending over a long period, I believe that the bid of the Rochester Railway & Light Company is exceedingly liberal and I would recommend its acceptance.

Special Lighting of Downtown Streets.

In view of the fact that throughout the country there is considerable interest in plans for the special lighting of some of the principal business thoroughfares of a city, it may be of value to central station managers who are interested in securing this class of business to have before them a brief review of what has been done in a number of American cities. The motive which actuates merchants or city authorities to provide special decorative illumination for the principal business streets is that of civic pride and a desire to make the business streets attractive at night both to out-of-town visitors and to residents of the city, in order that trade may be stimulated. We do not propose here to go into a complete or thorough history of this kind of lighting, but will merely mention a number of examples in order to show the various schemes employed.

COLUMBUS, O.

One of the first cities to provide special lighting on its downtown streets was Columbus, O. At Columbus practically all

INCANDESCENT ARCH AT COLUMBUS.

of the retail business of the city is on its main thoroughfare, High Street. Here a number of years ago the Business Men's League brought about the erection of a number of arches for supporting incandescent lamps, as shown in the accompanying

illustration. These arches are of lattice steel construction and are supported on the steel poles, which also support the electric railway span wires. At the present time these arches extend for a distance of about a mile on High Street. There are also a few arches in other streets. The Business Men's League paid the first cost of these arches and for the lighting of them at first. Later an arrangement was made whereby they were turned over to the city and the city pays the bills but collects about one-half of the cost of operation from the merchants along the streets, the balance being paid out of the city treasury. The theory upon which this is done is, of course, that this special lighting is a benefit to the entire city as well as to the merchants along the street. There is no doubt that it is a good advertisement for the city over the state. The appearance of High Street at night is very pleasing and not likely to be soon forgotten by any visitors to the city. In fact, it is worth a considerable journey to see. The arches are placed two to a block. The blocks are about 600 ft. long. Each arch has 50 16-cp lamps on it. The service is supplied by the Columbus Railway & Light Company from its 110-220-volt direct-current underground network. Service for each arch is brought up through the pole. The lamps are turned on and off by a patrolman of the company. No city street arc lamps are used on the street while the arches are on. Late in the evening, when the arches are turned off, arc lamps supplied from the municipal plant are turned on. The Columbus Railway & Light Company supplies the arch lamps at a cost to the city of about 2½ cents per kw-hour. There are in all 26 arches in use in Columbus on High Street and other streets. Their first cost varies according to the price of steel. The first nine arches erected cost $75 each. The next cost $90 each and the last $115.

SAN ANTONIO, TEX.

At San Antonio, as described in these columns in the issue of September 1, 1906, a much smaller and simpler arch is used. These arches are simply angle irons placed on existing electric railway poles. An arch is placed between each pair of poles. San Antonio streets are narrow. On one street the arches contain 10 4-cp lamps and another slightly wider street 25 4-cp lamps. The Merchants' Associations on these streets pay for the extra illumination. The rate obtained by the San Antonio Gas & Electric Company for this service is the same as that obtained for sign and display lighting which is turned on and off by the company's patrolmen. This rate is equivalent to what the meter bills would be under a readiness-to-serve contract, or equivalent to 6 cents per kw-hour for electrical energy used plus 15 cents per 50-watt lamp connected or its equivalent.

LOS ANGELES, CAL.

An entirely different plan of incandescent street lighting is employed on the principal business streets of Los Angeles. This was fully described by Messrs. Western Underwood and V. R. Lansingh in the *Transactions* of the Illuminating Engineering Society, Vol. 1, No. 4, May, 1906. An abstract of this paper was given in these columns, May 19, 1906, page 1038. The type of post adopted for Spring Street has four arms with twelve 12-in. globes roughed inside, each containing three 16-cp lamps and one large center ball 16 in. in diameter with six 32-cp lamps. Posts are placed about 100 ft. apart on each side of the street. This, of course, calls for a lavish expenditure of energy per mile of street, as the consumption is about 12 amperes at 110 volts for every 50 feet. The results as far as even illumination and artistic appearance are concerned are very pleasing. The authors note in the paper just referred to that a similar scheme of lighting has been used in Pasadena, Cal. There the posts are provided with 12 arms in a pendant position, giving a sort of spray effect, with a large upright globe in the center. Each of these arms is provided with a 16-cp lamp in a 6-in. ball. A short stretch on Michigan Avenue, Chicago, from Van Buren Street south, has been equipped with posts somewhat similar to those in Los Angeles.

MINNEAPOLIS, MINN.

In Minneapolis, as described in these columns of June 2, 1906, the Minneapolis General Electric Company is taking individual contracts from merchants along the business streets whereby arc lamps on a uniform design of post are placed every 20 ft. along the edge of the sidewalk. The arc lamps used are 3.25-amp., 110-volt, direct-current lamps. It is needless to say that the streets in front of stores engaging this service are brilliantly lighted. The company erects these poles at $10 each and agrees to keep the lamps lighted from dusk to 11 p. m. for $3 per month, on a five-year contract.

CLEVELAND, O.

Euclid Avenue and Superior Streets in Cleveland have been provided with special arc lighting for several years. On Euclid Avenue a post with a 5.5-amp., 110-volt, direct-current arc lamp is placed every 52 ft. on each side of the street. Current is supplied by the Cleveland Electric Illuminating Company and is turned on and off by means of a solenoid switch. The company has contracts for lighting 6,500 lineal feet of street with this special lighting. The cost to the merchants is $1.35 per front foot of street per year.

LINCOLN, NEB.

At Lincoln, Neb., during the recent state fair the principal street was decorated with strings of lamps suspended between the electric railway poles. The Commercial Club of the city appointed a lighting committee which arranged for this special display. The effect was so good that after the fair some of the leading business men in each block visited the others in their blocks and it was arranged to continue the special lighting until after the holidays. With such a start it would seem not unlikely that this special lighting will become a permanent thing in Lincoln. Service is supplied by the Lincoln Traction Company. The plan is somewhat temporary and consists of simply suspending the lamps from a pair of conducting wires. The lamps are in weatherproof sockets and hang by their leading-in wires. Four of these strands are placed in each block. Each strand contains 38 4-cp lamps. The price received is $20 per month per block for a service of 4½ hours each night. The subscriptions for the lighting were secured from the business men in each block by one of their number. The subscription lists were turned in to the Lincoln Traction Company for collection. In some cases the entire subscription was paid in advance. The lamps are fed from the secondary alternating-current mains of the Lincoln Traction Company. There is one switch for controlling the lamps of each block.

An excellent inexpensive plan which has been employed in a number of small towns is that of having a string of lamps suspended lengthwise of the street along the curb line at a height of about 15 ft. above the sidewalk. This is inexpensive to install and hence is within the reach of the pocketbooks of merchants in small towns. It adds much to the appearance of the down-town streets at night when the string of lamps between posts is kept in good condition. At Maquoketa, Iowa, the Barnes Electric Light & Power Company furnishes a string of such lamps on each side of Main Street at 35 cents per month per 16-cp lamp. Lamps are turned off at midnight.

An Enterprising Michigan Central Station.

The central station company in the little town of Kalkaska, Mich., offers an example of enterprise in developing its possible business that could well be followed by many companies both in large and small towns. Some of the remarkable results attained by this company were described at the recent Michigan Electric Association convention by Mr. A. E. Palmer, secretary and treasurer of the company. Kalkaska had a population of 1,304 in 1900. The population at present is given by Mr. Palmer as between 1,500 and 1,700. It is essentially a farming community with a small amount of manufacturing. The town has been lighted by electricity for 15 years past. The original plant was a direct-current outfit placed in a saw mill. It attempted to make a living on a flat-rate system of charging until several years ago it failed and a few public-spirited citizens of Kalkaska formed the Kalkaska Light & Power Company and developed water power on the Kalkaska River, about five miles from town. The present plant is about three years old. The water-power development cost considerably more than was at

first anticipated and the unusual amount of business secured by the company is the result of well-directed effort on the part of the management to put the plant on a basis where it would pay interest on this investment. The amount invested in the plant is about $30,000.

NEARLY $6 PER CAPITA.

The gross earnings are now about $9,000 per year. The company started in with a connected lamp load of one thousand 50-watt lamps. It now has about 3,000. One of the most remarkable things about the company's business is its day load, which is about 80 per cent of its winter peak load and is in excess of its summer evening lighting peak load. The maximum load is 29 amperes at 2,100 volts. The plant at present has one 100-kw, single-phase generator. It is intended ultimately to increase the water-power head and install another 100-kw generator. The transmission into town is by a 10,000-volt, single-phase transmission line. A fireproof sub-station in the town is used for the step-down transformers reducing from 11,000 to 2,100 volts. Everything is placed on meter. The percentage of energy sold to energy generated is about 78. When the company started to give 24-hour service it had no promise of a day load. The first year it lost money on its day load. It has since assumed the proportions relative to the winter peak that have been already given. It goes without saying that the company is turning nearly all the wheels in town, although it has been obliged to refuse to take a large motor with a very fluctuating load for fear of ruining the voltage regulation of its lighting service.

CITY WATER PUMPING.

The pumping of city water is done by single-phase Wagner motors. This water works installation is extremely interesting because the water works has no standpipe, being a direct-pressure system with the pumps operating continuously to maintain water service. The water pumping was formerly done by a steam plant, which is still kept as a reserve, although the single-phase motors used for pumping are installed in duplicate, each motor being of 20 hp. The maintenance of constant pressure with a constant-speed, single-phase induction motor was a nice mechanical problem. The motors are belted to a jack shaft. The pumps are belted to the jack shaft by cone pulleys with three speeds. Between speeds afforded by the different pulleys there is a bypass for further regulation of the pressure. The pressure maintained is 35 lb. Water is taken from a reservoir near the river. About 200,000 gal. of water is pumped per day. The contract provides that the company shall receive $2,250 per year for the pumping service until the monthly average exceeds 300,000 gal. per day. Water pumped in excess of this average is to be paid for at the same rate as the 300,000 gal. The daily amount of water pumped is averaged for a month and the daily average for the month is taken as the basis of payment. If this average is in excess of 300,000 gallons, payment for the excess is made pro rata. Because of the fact that this is a direct-pressure system, it is necessary to keep a man in attendance at the pumping station. As there is very little labor connected with the job, one man looks after the pumps for the entire 24 hours. Once set they will run all night without attention, unless there is a fire. This man is paid $35 per month by the company and is furnished a house near the plant by the city. The company simply pumps the water, taking it from the reservoir and delivering it to the mains. It has no responsibility for the mains or distribution system or for the water supply.

FARM TRANSMISSION LINES.

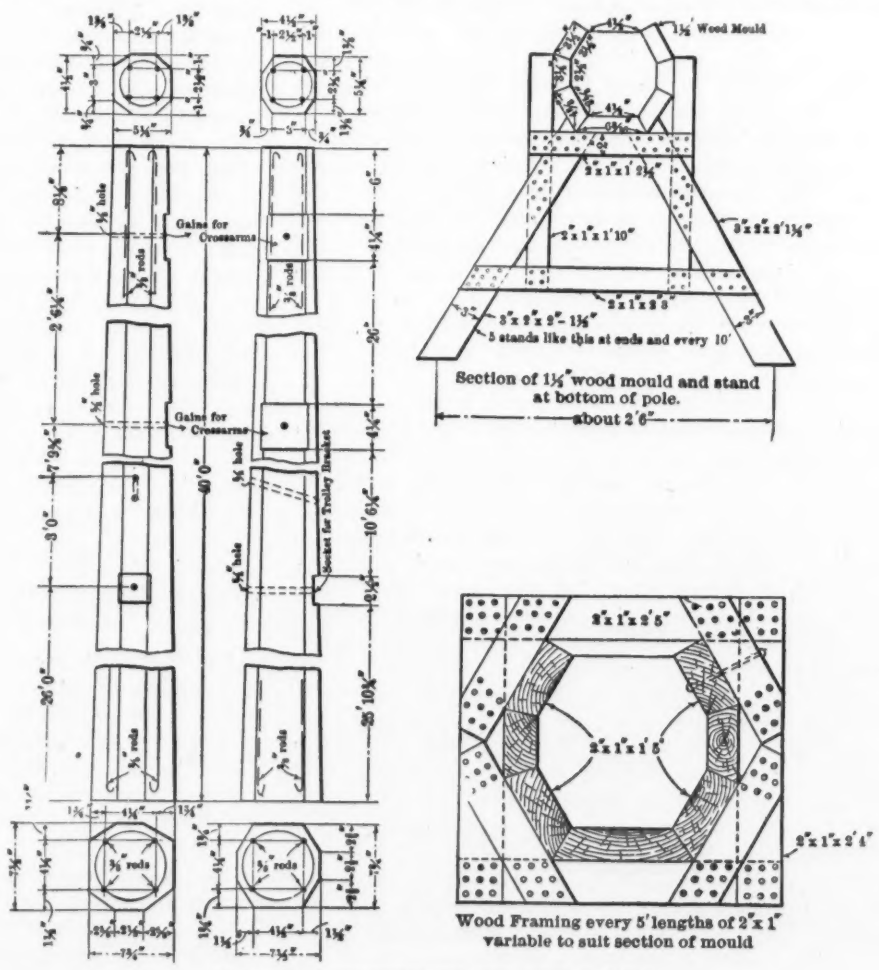
Considerable has been thought about the possibilities of transmission lines to farms. Mr. Palmer himself lives four miles out from Kalkaska. He has built a single-phase transmission line of No. 9 soft galvanized iron wire. This supplies a connected residence load of 40 lamps, and a 5-hp motor used for miscellaneous purposes. The maximum voltage drop over this line with this load is almost unappreciable. It is thought that perhaps several farmers' settlements may be supplied in this way, enough to take 25 per cent of the plant's capacity.

This little plant has in service among its residence customers 112 electric irons, having probably more irons per hundred of population than any other town in the state.

The company has not hesitated to take some chances by purchasing motors and installing them on trial for customers, but it has never failed to secure the customer and sell the motor by this procedure.

Concrete Trolley Poles.

Mr. C. A. Alderman, chief engineer of the Cincinnati & Northern Traction Company, in a paper read before the Street Railway Convention entitled "Ties, Poles and Posts," submitted a drawing of a reinforced concrete trolley pole which he expects to see used to a very large extent within the next few years. The greatest objection to the concrete pole is its weight; it will have to be set with a derrick, but this can be done for not a very large cost. Concrete posts, he said, have been used very largely and are no longer an experiment. The illustration shows plan and sectional views of the concrete form, and gives details of the framing of the form and its support.



REINFORCED CONCRETE TROLLEY POLE DETAILS.

The Burning of Cheap Fuel.

For the burning of cheap fuel there are two general systems in use: one using the shaking grate and the other using a stationary grate; both employing a blast. Both systems have their adherents and both show up well under test. For years the average boiler plant has been accustomed to operate with coal ranging in size from No. 1 buckwheat upwards in the anthracite markets and very largely run-of-mine in the bituminous coal regions. Realizing that fuels of practically equal heat value but in smaller sizes and at consequently less price were obtainable, Mr. H. E. Parson some time ago began to develop combustion along these specific lines and finally brought out a complete system for burning these cheaper fuels which does not entail either expensive construction or produce onerous conditions for the fireman.

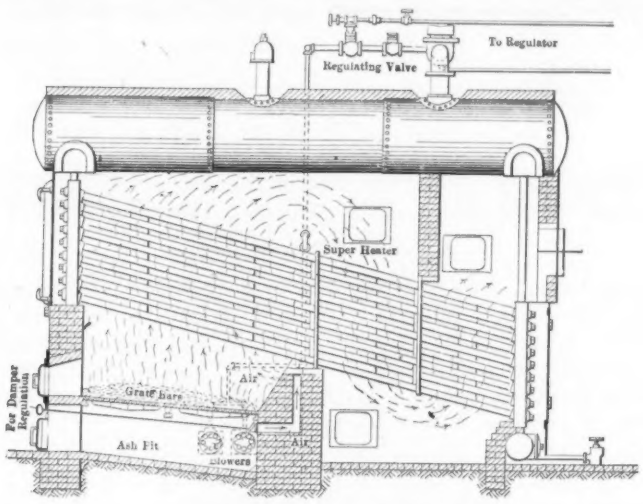


FIG. 1.—PARSON SYSTEM APPLIED TO BABCOCK & WILCOX BOILER.

The Parson system comprises a grate bar especially designed for the holding of these fine fuels without loss, a steam blower, a superheater for the steam supplied to the blower, means whereby additional air can be supplied to accelerate combustion, and an automatic control of the draft. The grate bar is shown in Fig. 5 herewith and is designed to hold the finer anthracite and bituminous coal without loss through the bar, either in cleaning fires or manipulating the fuel for any reason. The grate is termed a pin-hole grate and has about 15 per cent of air space, whereas natural draft bars usually contain about 40 per cent of air space and upwards. It is contended by the adherents of the pin-hole grate that with the shaking grate fuel is lost in the cleaning process, which is never reclaimed, and which shows up in the ash-pit. To obviate this loss in cleaning fires a dumping dead plate is employed by means of which the grates can be cleaned without difficulty, the ash disposed of at the fireman's convenience or by means of underground ash tunnels common in large plants.

When the fires are to be cleaned this patented platform is covered with fire by pushing back the live coal. The ash remaining on the grate bars is thus separated from the coal and is withdrawn through the furnace doors. The coal is pulled over the grates from the cleaning platform and fresh coal is added. With No. 3 buckwheat the bed of fuel is usually 10 in. thick before cleaning is necessary. The same rules apply to the firing with this system as with the shaking grate system; the coal should be fired light and often. Also with this system the Dutch oven or reverberatory arch over the fire is in most cases an advantage.

The steam blower used in connection with the blast is said to operate with as low as one and one-half per cent of the boiler's steam production, depending on the quality of the coal used. The blower is of the single jet type and is governed by a set of special washers, which by increasing or diminishing the size of outlet change the ratio of blast produced. These washers are supplied to the plant management so that the change of blast is in the hands of the owners at all times as the jets cannot be changed unless the washers are changed. The designer of the system has preferred the steam blower for draft purposes because it is self-contained and capable of being incorporated in the boiler setting rendering each boiler a separate unit at all times. In most cases the draft is introduced from the rear and not from the front as in the shaking grate systems. The superheater for the blower is designed for efficient work and is capable of ready renewal. The blower receives steam from the boiler through the superheater pipe, the amount being regulated by a valve. The function of the blower is to inject this adjustable jet of superheated steam into a conductor pipe causing a strong draft in consequence in the ash-pit and insuring a mixture of steam and heated air so essential for the burning of cheap fuels.

Because analyses of flue gases have shown combustible gases unconsumed, a means was developed by which air could be fed above the fire. The amount of air supplied can be regulated and supplied only at the time the fires are in active combustion. The method of feeding depends on the type of boiler used. With the ordinary return tubular boiler and also with the Heine boiler with horizontal baffles, this supply of air is driven through openings in the bridge wall above the fire. Instead of building the ordinary straight bridge wall, the wall is built as shown in Fig. 2 with a cleaning platform capable of holding all the good coal on the grate. In the Babcock & Wilcox and Stirling boilers the auxiliary supply of air is injected over the front arch.

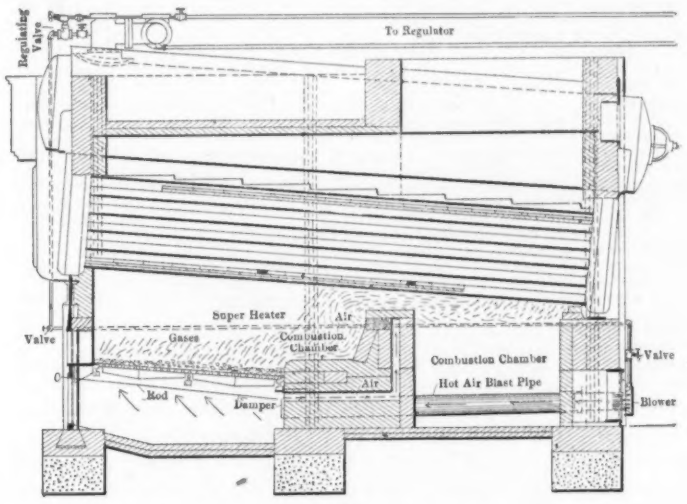


FIG. 2.—PARSON SYSTEM APPLIED TO HEINE BOILER.

The regulator supplied with the system is said to be capable of controlling the steam pressure to within one pound variation.

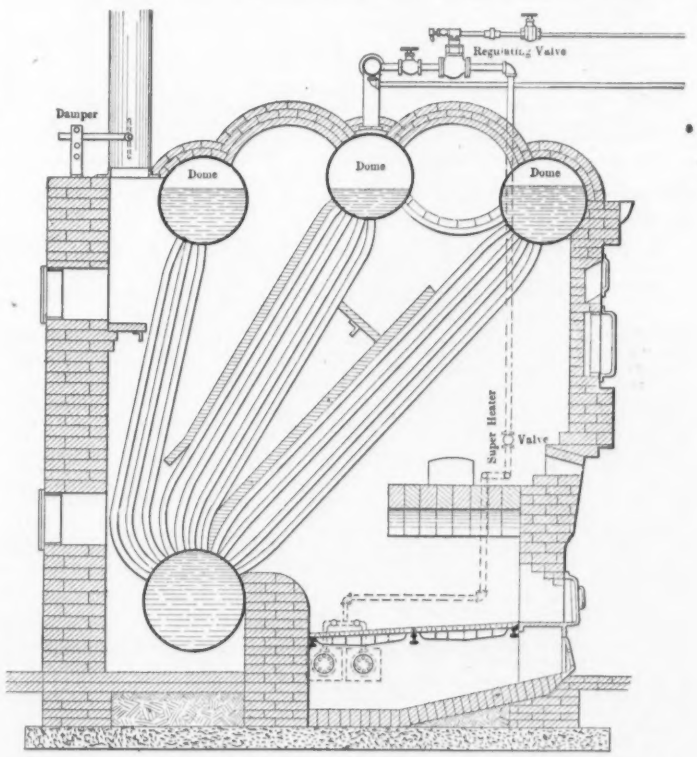


FIG. 3.—PARSON SYSTEM APPLIED TO STIRLING BOILER.

The regulator acts by steam pressure only. When the steam pressure in the boiler falls below a predetermined amount a weighted lever actuates a steam valve so as to admit steam to the regulator cylinder. A piston in this cylinder is forced to move, opening the chimney damper in so doing and at the same time openin

the blower valve against the pull of its loaded weight. Steam is thereby admitted to a superheating pipe just above the fire from which it passes to the blower nozzle in the outer end of the hot blast pipe. The inner end of this pipe delivers the air drawn in the nozzles to the ash-pit and a part of this air is also delivered above the fire to facilitate the combustion of gases as previously explained. This stream passes from the hot blast pipe to the fire by way of a flue in the bridge wall and is regulated by a damper in the aperture opening into the flue.

TEST OF B. & W. BOILER AT PLANT OF NATIONAL CALF SKIN CO., PEABODY, MASS.

Grate surface	67 sq. ft.
Heating surface	3020 sq. ft.
Duration of test	5 hours
Temperature of feed water	69.7° F.
Average steam pressure	111.8 lbs.
Rated horse-power of boiler	302 hp.
Fuel used	75% Birdseye, 25% bituminous
Cost per ton	Birdseye, $2.41; Bituminous, $3.55
Cost per ton mixture	$2.69
Total fuel used	9,891 lbs.
Percentage of moisture in fuel	5.5%
Total dry fuel	9,347 lbs.
Refuse	1,069 lbs.
Per cent. of refuse	11.44%
Combustible	8,278 lbs.
Total water fed to boiler	73,337 lbs.
Factor of evaporation	1.1904
Equivalent water evaporated from and at 212°, net	86,121 lbs.
Ash pit pressure	1 in.
Stack draft	4/10 in.
Temperature of flue gases	492.2° F.
Water per lb. of coal, actual conditions	7.414 lbs.
Water per lb. of combustible, from and at 212°, net	10.403 lbs.
Horse-power developed per hour, net	499.2 hp.
Fuel burned per sq. ft. of grate surface per hour, dry	27.9 lbs.
Cost of fuel for 100 hp per hour	$0.515
Fires cleaned	Start, middle and end of test
Clinkers	None
Blowers used	2
Washers used	10
Actual times in operation during test	Continuously

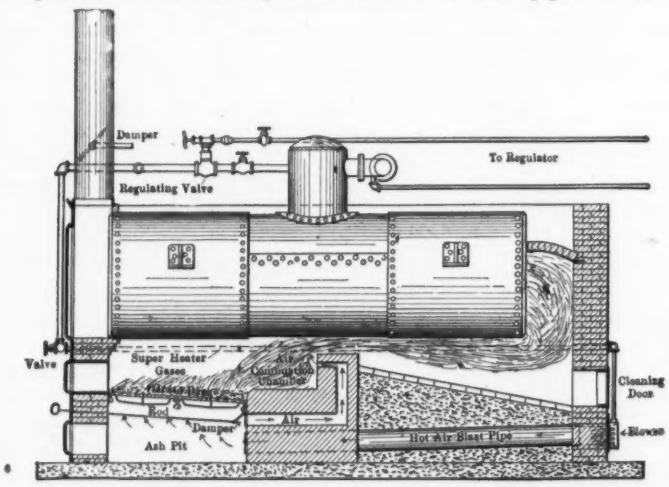


FIG. 4.—PARSON SYSTEM APPLIED TO A RETURN-TUBULAR BOILER.

It would seem that much work were necessary to make such an installation, but such is not the case as practically the only alteration inside the boiler is in the bridge wall, and such other changes as are made necessary by the new bearing bars required for the grates. A feature of the system is that the blowers only work when steam is below the required working pressure and automatically stop when that pressure is reached. The draft regulation is, therefore, taken out of the hands of the fireman, who has only to feed and clean the fire and look after the feed water. Where automatic feed-water regulators are installed the latter duty is also taken away from the fireman so that with a proper installation the cheaper grades of fuel may be burned to advantage and with profit to the central station. Recent tests on boilers fitted with this system and fed with cheap fuel are given in tabulated form herewith:

TEST OF B. & W. BOILER AT CENTRAL RAILROAD SHOPS, ASHLEY PLAINS, PA.

Grate surface	66.5 sq. ft.
Duration of test	8 hours
Temperature of feed water	64° F.
Average steam pressure	109.5 lbs.
Rated horse-power of boiler	250 hp.
Fuel used	Washery No. 3 Buck.
Cost per ton of 2,240 lbs	$0.25
Total fuel used	7,500 lbs.
Percentage of moisture in fuel	6%
Total dry fuel	7,050 lbs.
Refuse	1,230 lbs.
Percent. of refuse	17.45%
Combustible	5,820 lbs.
Total water fed to boiler	56,368 lbs.
Equivalent water evaporated from and at 212°	67,358 lbs.
Stack draft	3-10 in.
Temperature of flue gases	427° F.
Water per pound of coal, actual conditions	7.516 lbs.
Factor of evaporation	1.195
Water per pound of combustible from and at 212°	11.57 lbs.
Horse-power developed per hour	244 hp.
Fuel burned per sq. ft. of grate surface an hour dry	13.25 lbs.
Cost of fuel for 100 hp per hour	$0.039
Fires cleaned	Twice
Clinkers	None
Blowers used	2
Washers used	5 each
Blower auxiliary	1
Washers used	1
Actual time in operation during test	75%

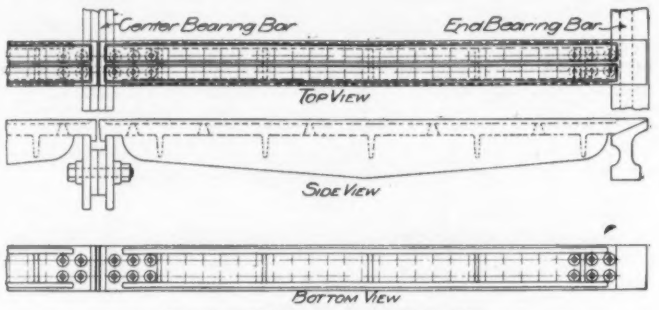
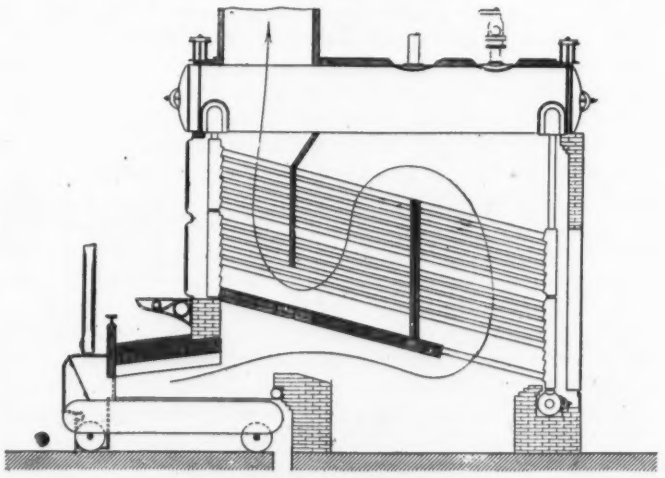


FIG. 5.—VIEWS OF PARSON GRATE.

Smoke Suppression.

Mr. A. Bement, the consulting engineer of Chicago, who has made a specialty of coals and combustion problems, and who has done considerable investigation of value in the plants of the Chicago Edison Company, presented a paper before the Western Society of Engineers in Chicago, October 17, in which the following suggestion as to a boiler furnace construction to secure smokeless combustion was made:

The accompanying illustration shows an improved type of smoke-proof steam generator, its furnace chamber being formed by tiles covering the lower row of the tubes of the boiler. It is not a patented apparatus and may be adopted by anyone who wishes to do so. In fact many boiler plants now installed may at small expense be altered so as to conform to all of its essential requirements. While this particular improved apparatus has already been built when demanded by purchasers, no manufacturer is willing to erect it unless required to do so. The nearest approach to a smoke-proof apparatus in the form of a complete steam generator, offered by any maker, consists of a brick arch as an essential adjunct for the direction of the gases against the tubes of the boiler, and when this manufacturer installs a chain grate under this arch it becomes the above-mentioned exception to the rule. This does not mean, however, that a purchaser may not buy a boiler from one maker, a stoker from another and with a little engineering produce an apparatus which is strictly smokeless.



SMOKE-PROOF STEAM BOILER.

Some Characteristics of Coal as Affecting Performance with Steam Boilers.

In order to determine the effect on the capacity and the efficiency of steam boilers due to coal of different sizes, the influence of ash in the coal on the capacity and the efficiency, the effect of the variation in the size of coal screenings and the results of different thicknesses of fire, W. L. Abbott made a number of tests and experiments, the results of which are embodied in a paper read before the Western Society of Engineers. The apparatus employed in the researches consisted of

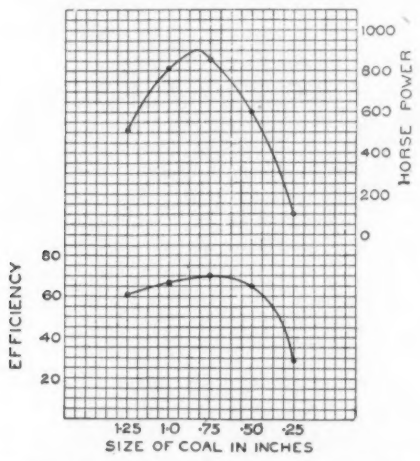


FIG. 1.—EFFECT PRODUCED BY COAL OF VARYING SIZES.

two Babcock & Wilcox boilers, one being 14 tubes high and 18 wide, of approximately 5,000 sq. ft. of heating surface, fitted with a chain grate stoker 75 sq. ft. in area, which discharged the gases of the fire from under an ignition arch 5 ft. long, immediately among the tubes of the boiler; this boiler was also fitted with a Babcock & Wilcox superheater having an approximate area of 1,000 sq. ft. The other apparatus employed in one of the series of tests differed only in sizes; its boiler was 12 tubes high and 16 wide, contained 4,000 sq. ft. of heating surface, provided with a superheater and served with a chain grate stoker 66 sq. ft. in area.

Fig. 1 shows the results of tests with five sizes of coal. The coal was all from one lot so that the different portions resulting

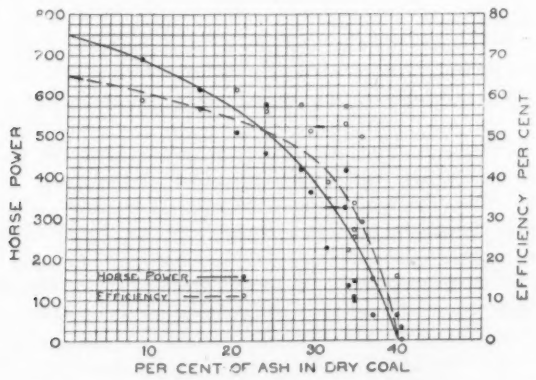


FIG. 2.—INFLUENCE OF VARYING PERCENTAGE OF ASH IN COAL.

from the screening process were necessarily the same kind of fuel. The percentage of ash in the various sizes is given in the accompanying table:

Size of coal in inches.....	Square screens. Through.	Over.	Ash in Dry coal.
" " "	1.25	1.00	13.7
" " "	1.00	0.75	14.0
" " "	0.75	0.50	15.6
" " "	0.50	0.25	20.8
" " "	0.25	0.00	30.8

The high per cent in the smallest size is not due to ash in the coal itself, but to the fact that all of the fine sized foreign matter separated from larger coal, or which comes from the roof of the mine, naturally finds its way into the smaller coal.

Fig. 2 shows the results of eighteen tests made to determine the effect of varying quantities of ash associated with coal. If ash acted only as a dilutant, a proportionately less amount of water would be evaporated by a pound of such mixture, but the efficiency would not be affected, if however ash acts as an obstruction to the combustion, the effect of its presence is doubly harmful.

To insure that the result would not be affected by any influence other than that of ash, special coal was used which came from the No. 7 seam, north of Marion in Williamson County, Ill. It was prepared in a Stewart washer and is known to the trade as No. 4 washed coal. The test indicated by the two points showing highest efficiency and capacity was made with coal just as it arrived. Beginning with the test of the second day, a quantity of refuse from the stoker ash pits was added to the coal to be used. This refuse was first weighed and broken up, after which it was thoroughly mixed with the coal in the required proportions and increasing amounts added

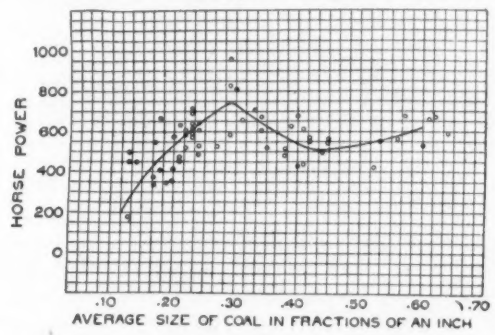


FIG. 3.—EFFECT OF SIZE OF COAL SCREENINGS ON CAPACITY.

in each test which followed. It appears from the diagram that useful effect from the fuel drops to zero with 40 per cent of ash. The fact should be emphasized, that although over half of the mixture fed to the fire was fuel, it burned without producing any useful effect. The author assigns two reasons for this; one, that on account of obstructed air supply through the fuel bed, incomplete combustion and escaping hydrocarbons carried away a portion of the heat because the gases passed immediately among the tubes of the boiler; the other, that owing to the presence of an excess of ash, the percentage of fuel on the rear portion of the grate is greatly reduced. On this account a larger proportion of the air passing through the fuel bed does not combine with the fuel, but enters the furnace as free air. This lowering of temperature besides making a long

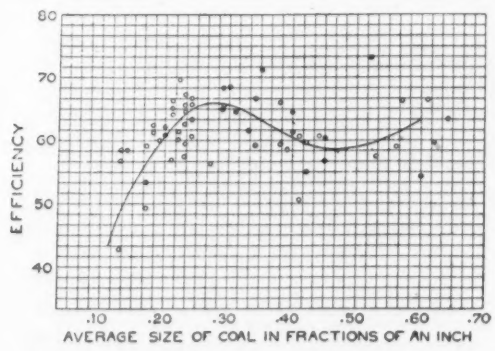


FIG. 4.—EFFECT OF SIZE OF COAL SCREENINGS ON EFFICIENCY.

smoky flame which reaches up among the tubes and is there chilled to below the ignition point also reacts on the fuel bed reducing the rate of combustion and still further increasing the adulteration of the furnace gases with free air. When the temperature of the furnace has been reduced to about 600° F., the boiler is unable to absorb any more heat than is necessary to make up for radiation losses.

In Illinois and Indiana, coal not sold as run-of-mine is separated largely as lump and screenings, and the latter furnish about 90 per cent of the stoker fuel used in Illinois. Figs. 3 and 4 illustrate the result of a large number of tests to determine the effect of variation in the size of coal screenings. The average sizes of coal as shown at the bottom of the diagrams,

were calculated from sizing tests, and represent the dimension in fractions of an inch of openings in a screen which would allow one-half of the coal to pass through and the other half to go over the screen, and it is this that is designated as its average size.

The curves for both efficiency and capacity drop midway between the tests with both small and large coal. This is a peculiarity which may be explained as follows: Performance becomes better as the size of coal increases, until a point is reached when the quantity of large pieces becomes so great that there is not enough fine material to properly close the interstices between, with the result that performance drops off, due to excess of air, until a condition is reached when all of the pieces of fuel approach uniformity, when owing to greater agreement in size, they fit together better, and in a measure produce a homogeneous mass similar to that secured by the fine dust filling the spaces in the fuel bed in the first case.

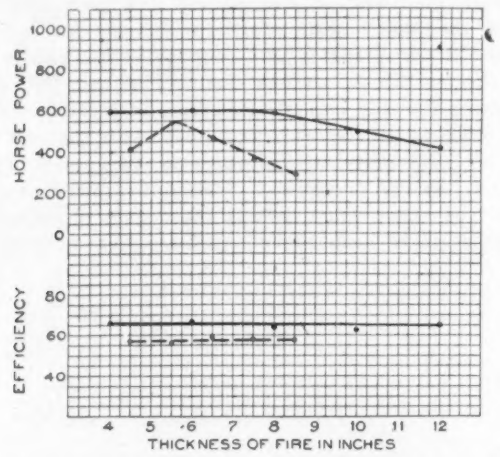


FIG. 5.—EFFICIENCY WITH VARYING THICKNESSES OF FIRE.

The presence of fine dust in excess is a great and important source of trouble. Referring to Fig. 1, coal through an 0.25-in. square screen produced only 108 hp, yet a size of fuel known in Illinois as No. 5 washed coal, which will pass through an 0.25-in. round hole (a smaller aperture than the square opening) will produce as high as 600 hp under the same boiler. It is true that the lower ash content of the washed coal has a considerable influence, but this is offset by the larger size of the square screen as against the round one.

To arrive at a better understanding of the physical make-up of these two characters of fuel, tests were made of the dust of each, using that quantity which would pass through a 20-mesh screen. The tests showed that the quantity of extremely fine dust through the 100-mesh screen was almost three times as much in the unwashed as with the washed coal. The average from five tests taken from different lots of screenings shows an approximate agreement with the quantities from the duff through a ¼-in. square screen, from which it follows that the presence of the fine dust has an enormous influence on the burning of the fuel.

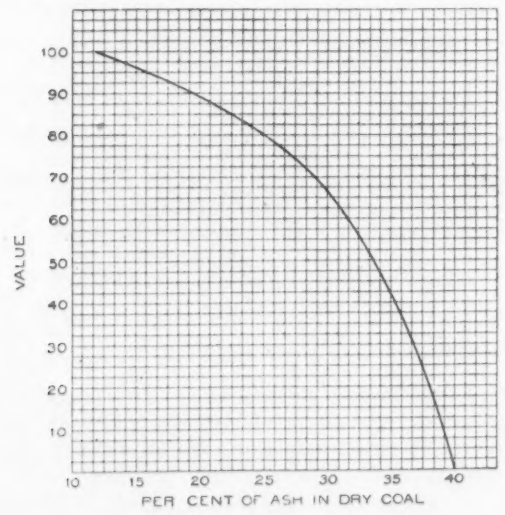


FIG. 6.—VALUE OF FUEL WITH ASH.

An excess of air accompanies a thin fire, and because of it, efficiency produced through the boiler is affected. On the other hand, a thick fire reduces the excess of air, but increases the volume of hydrocarbon gases which leave the surface, or in other words, makes more smoke. If a furnace is located between the boiler and stoker, these gases will be burned, otherwise they will largely escape among the tubes of the boiler as they did in this case. Therefore, under these conditions, a thin fire increases the loss due to excess of air, but decreases that due to smoke and incomplete combustion. On the other hand, a thick fire reduces the excess of air, but increases the smoke and escaping combustible gas, and so the best thickness of fire may be a matter of importance.

The curves of efficiency from a B. & W. boiler with tubes 14 high, shown in Fig. 5, illustrate a constant heat efficiency produced through the boiler for a full working range in thickness of fire, insuring not only a maximum excess of air but incomplete combustion loss as well. The efficiency, it will be noted, remained uniform, and the only opportunity for the skillful and intelligent fireman is in selecting that thickness best suited to capacity requirements. In the series with thickness of fire from 4.5 to 8.5 in. what is known as No. 5 washed coal was used. With the other series and a larger range in thickness, washed screenings were employed.

The value of coal screenings is affected by four variables, which are heating power, moisture, ash and size of the pieces of coal. Heating power in Illinois and Indiana of the pure coal

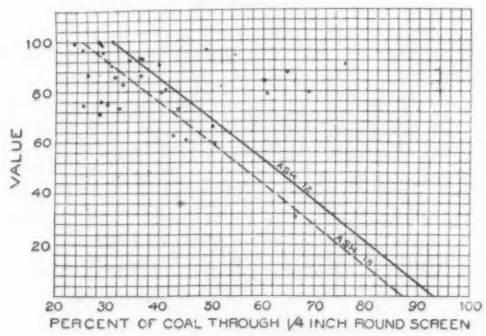


FIG. 7.—CURVES REPRESENTING VALUE FOR ASH CONTENT AND STANDARD ASH.

ranges from 13,800 as the minimum to a maximum of 14,500 B.t.u. per pound, and moisture from about 9 to 14 per cent. These two characteristics, however, are of minimum importance, as either can effect the result by only a comparatively small amount. With the other two features, amount of ash and size of the pieces, each may exert an influence of such moment that they cause the fuel to be valueless. Thus, in fuel inspection service it may be necessary to test only the latter characteristics.

The fuel in service under a boiler produces two results, one of efficiency and the other of capacity, and capacity, or in other words, quantity of steam produced, is a matter of great importance. Therefore, if these two effects may be averaged and treated as a single value, the problem is much simplified.

Inspection of diagrams Figs. 3 and 4 shows that resulting capacity and efficiency are approximately the same, and that the condition of fuel which results in a high efficiency also produces large capacity. This makes it possible to assign two values to the fuel, one applying to the ash content, the other to its size. The feature of size is a more difficult problem than that of ash and from Figs. 6 and 7 it appears that screenings having 12 per cent of ash or less and of a size that no more than 31 per cent will pass an 0.25-in. round screen may be considered of 100 per cent value. That is, since 12 per cent represents an average minimum ash content for coal screenings in Illinois and Indiana at the present time, therefore such fuel is the best obtainable and for this reason may have a value of 100 per cent assigned to it.

Boiler Room Economy.

BY EUGENE L. GRIGGS.

It is certainly economical in a large power plant to burn cheap fuel, but there should be ample boiler capacity to ensure holding the pressure up, as cheap coal will not make as much steam as good New River coal will. There should be boilers enough so that one can always be laid off for repairs without forcing the others.

A good cheap fuel is made of three parts screenings well mixed with one part of good soft coal. The soft coal holds the screenings together and makes it coke in good shape. Carry heavy fires, with a strong draft; forced or induced draft is the better. Screenings make a very dirty fire, which must be cleaned very often. If the boiler capacity is too small, the fires will have to be forced so hard that the furnace linings and grates will soon give out, and there will be lots of ashes and clinkers to handle, together with the added expense of hauling them away.

Good firemen are hard to get, and when any are obtained they should be retained and not be allowed to leave on some flimsy pretext, or on none whatever; humor them and use diplomacy. There should be a boss fireman in charge of the fire room of any power plant to see that the fires are properly handled, that they are of an even thickness throughout, with no air holes, free as far as possible from ashes and clinker and not mixed with green coal, but very hot clear through. Too much coal should not be put on at one time, either, for good results.

It detracts greatly from economy to admit too much excess air through the fire doors. It may reduce the smoke somewhat, but it cools the hot gases off to an alarming degree, where carried to extremes.

Where automatic stokers are used the rate of feed should be such that the coal is just consumed when it reaches the back end of the grate; otherwise good coal will be dumped into the ash-pans. On the contrary, if the feed is too slow the back end of the grate will be dead and give no heat.

Much can be gained by a very careful attention to the water, especially with water-tube boilers. It is the custom with a great many water tenders to let the water get very high or low in the glass before adjusting the feed checks. This is all wrong. When the water gets high in any particular boiler, it will for the time being generate wet steam, which, of course, is wasteful. If the water is too high in all the boilers they will all make wet steam.

A great many boilers in power plants are allowed to get very dirty before cleaning. Now the added expense of cleaning is much more than offset by the saving in coal; it pays to keep a boiler clean, and moreover, clean boilers don't have to be driven so hard, are easier on firemen, grates, linings,etc., and give better satisfaction.

A much greater loss than is generally supposed can be traced to leaky settings. The writer wishes he could show some of the settings he has seen, chock full of cracks and holes all over. I have in mind a certain small plant where there are two boilers, and when it was new, one of them used to keep the steam up all right. The settings being very thin are now leaking so badly that both boilers can hardly do the work, and they are burning lots more coal. The management is too stingy and doesn't want to take the trouble to reset those boilers (penny wise and pound foolish). Think of the loss in a plant where there are twenty boilers!

Boilers should very frequently be cleaned both inside and out, back connections, tubes and ash pans kept free of ashes and soot and inside clear of grease, scale and sediment. Have the tubes blown every day and swept two or three times a week if possible.

Now I come to a point that I would like to impress on superintendents and engineers, and that is the necessity of equipping all tubular boilers with surface blow-offs. Every marine boiler is so equipped, but very few land boilers are, and why? Because the men on land don't know enough to do it. A surface blow properly fitted should have either one or two large iron pans placed centrally in the boiler just above the tubes. When the valve is opened all the surface impurities are sucked into these pans and then discharged into the main blow-off pipe. Both surface and bottom blows should be used every day.

The best way to stop steam leaks is to get right after them; take the bull by the horns. Have a note book in which enter in red ink the location of all leaks as fast as they are discovered. Whenever a leak is fixed, cross it off the book; those that are left not crossed off are a constant reminder. I think it is a good plan to keep account of everything around the plant in a note-book; if too much is trusted to the memory, one is apt to forget.

I once knew of a plant where there were fifteen boilers and seven compound engines. The chief engineer was one of those slack, devil-may-care kind of fellows who let everything go just as long as he possibly could, with the result that after a time the whole plant got all run down and they were using lots of coal and water to keep things going. It was finally decided to engage a new chief. He came.

He began in the boiler room. He laid off one boiler at a time and had it reset, new furnace linings, grates overhauled, safety valves and fittings made tight, etc. After all fifteen boilers had been put in good order he turned his attention to the boiler room piping and had that all made over where needed. Then the pumps received attention, were packed, valves set, new linings in water end, and so on.

After everything possible had been done in the fire room the chief turned his attention to the engine room. Each engine had any needed repairs made, was indicated, valves adjusted and otherwise put in the pink of condition. Some of the commutators were turned down, brushes overhauled, grounds detected and remedied. Then the engine room piping was looked to and all leaky joints made over.

All the foregoing repairs took time and money, but I wish you could have seen that coal bill come down. It dropped fully thirty per cent, and the water bill eased off considerably, too. The chief engineer received a substantial increase in his pay. So much for attention to details.

Selection of a Steam Engine.

BY CHAS. L. HUBBARD.

Steam engines may be classified in different ways according to their mechanical construction, although there is no definite line of distinction.

They are designed to operate at both high and low speeds, are made vertical and horizontal, and are constructed with either single or multiple cylinders according to the requirements.

They may, however, in a general way, be included under the heads of slow-speed, moderate-speed, and high-speed, and will be taken up in this order.

Slow-speed engines are commonly characterized by speeds of 100 revolutions per minute or under, a stroke of 36 to 72 inches, independent steam and exhaust valves, the former being of the Corliss or other drop cut-off type, and are regulated by means of a fly-ball governor.

They are well adapted to factory work and for driving belted dynamos. The larger sizes are used to a considerable extent with direct connected machines, the latter being especially designed to operate at slow speeds. Condensation is greater in slow-speed than in high-speed engines, because the steam remains in contact with the cylinder walls for a greater length of time at each stroke. This, however, is usually more than offset by the smaller clearance and more efficient valve gears which may be employed at slow speeds, so that as a class, this type of engine is more efficient than the high-speed.

Following, and to some extent overlapping the preceding type, are the medium-speed engines. These commonly run at a speed of 100 to 175 revolutions per minute, have a stroke of 24 to 42 inches, four valves positively driven, either by one or two eccentrics, side-crank construction, and automatic shaft governor. They are adapted to locations where lack of space prohibits the use of

a slow-speed engine, and where for any reason an excessively high speed would be undesirable. They are used for both power and lighting service, and may be directly connected with generators of suitable design.

High-speed engines in most cases have a single valve, usually some modification of the slide valve, connected directly with the eccentric and controlled by an automatic shaft governor. They have come into general use of late years for driving electric generators, on account of the desirability of connecting the generator directly with the shaft of the engine. This change has made it necessary to modify the general design somewhat, in order to overcome the effects of higher speeds.

The reciprocating parts must be made lighter to reduce vibration, and must be more carefully proportioned to maintain a proper balance. The bearings must be made much larger, and special care taken to keep them in adjustment.

In slow-speed engines the oil cups are easily watched, and any part of the engine can be oiled while running. This is impossible with those of high speed, and special means must be provided for supplying plenty of oil to the bearings and cylinder. Forced lubrication is often employed, with the running parts enclosed to prevent the throwing of oil. This type of engine is made very compact, and with a short stroke as compared with those of slower speed.

Simple engines include those in which the total expansion of the steam takes place in a single cylinder. They may have one or more cylinders, but in the latter case both take steam at boiler pressure and exhaust into the atmosphere or condenser as the case may be. Simple engines cost less per horse-power than compound, and are not so complicated as the latter; but on the other hand they are more wasteful in the use of steam.

Compound engines commonly have two cylinders, so arranged that steam first enters the high pressure cylinder, expands, and then exhausts into the low-pressure cylinder where the expansion is completed.

Some engineers proportion the cylinders so that approximately the same amount of work is done in each, while others claim it is better to make the temperature range of the steam more nearly equal. There are various rules for determining the proper ratio between the cylinders, a simple one being to make it equal to the square root of the total ratio of expansion. For example, if the ratio of expansion is 9, the ratio of the cylinder volume will be $\sqrt{9} = 3$; that is, the volume of the low-pressure cylinder should be three times that of the high-pressure cylinder.

The most common forms of the compound engine are the tandem and cross-compound.

In the first arrangement, both pistons are placed upon the same rod with the axes of the cylinders in line. Only one set of reciprocating parts is required, and except for the two sets of cylinders, pistons, and valves, the appearance is the same as that of a simple engine.

Cross-compound engines are made up of two complete machines, except the main shaft and fly-wheel which are common to both. One advantage which this form has over the simple and tandem engines, is that the cranks may be set at 90 degrees from each other, so that when one is on a dead center, the other is at a position of nearly its greatest effort. This makes a dead center impossible and gives a more uniform turning moment.

When the cranks are set in this manner, the low-pressure piston is not ready to receive steam when the high pressure exhausts. This condition is overcome by placing a receiver between the two cylinders, and into which the high-pressure cylinder may exhaust and from which the low pressure takes its supply.

This is sometimes done away with by placing the cranks either in the same position or opposite, so that the strokes begin and end together. In this case the steam exhausts from the high-pressure cylinder directly into the low pressure; but when this is done, the advantage of a uniform turning moment is lost.

Cross-compound engines are more expensive to make, and require more floor space than tandem engines, while the labor of cleaning and oiling is nearly doubled. On the other hand, the individual parts may be made lighter and are thus more easily handled.

In triple-expansion engines the steam is expanded in three stages instead of two. Three cylinders are usually employed, the high, intermediate, and low, with the cranks 120 degrees apart.

Sometimes four cylinders are used instead of three, the volume of the low-pressure cylinder being divided into two, which gives a better balance. Triple-expansion engines are more frequently used in marine work and large pumping stations and are not well adapted for use in connection with heating plants, being much more expensive and complicated than would be warranted by the gain in economy.

Although made in smaller sizes, the use of the steam turbine in this country, up to the present time, has been confined principally to the driving of generators in large power plants. While there is no mechanical difficulty in its being operated non-condensing or at moderate pressures, the best efficiency is secured when supplied with steam at a high initial pressure and run condensing.

Its desirability for isolated plants of small or moderate size, and especially those in which the exhaust steam is utilized for heating purposes has not yet been fully demonstrated, and can only be determined after careful trial under actual working conditions.

Turbines, owing to their high speed and uniform efficiency under a considerable variation in load, are particularly adapted to the driving of electric generators, to which they may be directly connected. They require small foundations and take up little space, and owing to the small number of moving parts, the friction is slight. Another advantage is the ability to use highly superheated steam, as no lubricating oil is required, and as the same parts of the interior are always exposed to steam of practically the same temperature, the loss from condensation is small. The steam consumption of turbines is about the same as that of the best reciprocating engines, having been gradually reduced by various improvements in their construction.

Where a slow speed is required, the reciprocating engine is probably the best, and how far the turbine will supersede the older type of engine can only be shown by future developments.

The principle upon which a turbine acts is different from that of a reciprocating engine. It does not derive its power from the static force of steam expanding behind a piston, but instead, the expansion produces a high velocity in a jet of steam, which is made to strike the vanes of a revolving wheel and thus gives up its kinetic energy in turning the wheel and so produces work.

The jet must strike the vanes without shock, and leave them in another direction without any sharp deflection. The action of the steam varies somewhat in different types of machines. In some cases the turbine wheel is rotated by the impact of a jet of steam upon the vanes, and in others by the reaction of a jet of escaping steam upon the wheel. The former are called impulse turbines, and the latter reaction turbines. In some makes the two actions are combined in the same machine.

The selection of an engine for any particular location depends upon the conditions under which it is to operate. For sizes under 100 hp, and especially where the exhaust steam is to be used for heating purposes, the simple non-condensing engine is generally used. For larger sizes, and where the steam pressure is over 120 pounds, the compound engine is often advocated upon the ground of economy.

The first cost of a compound engine is considerably more, being perhaps 30 per cent greater for the average machine. The steam consumption in the case of high-speed non-condensing engines at full load, is from 20 to 30 per cent less for the compound, while the increase in fuel consumption required to raise the boiler pressure from 80 to 125 pounds is only about 1 per cent. When all of the exhaust is used for heating, there is of course nothing to be gained by installing a high-priced engine for the sake of reducing the steam consumption. But on the other hand, if the exhaust can only be used for a comparatively small part of the year, or if but a portion of it can be utilized in the heating system, then the saving will often offset the interest and depreciation charges upon the additional first cost, and leave a good margin of profit besides. This being especially true in localities where the cost of fuel is high.

In making a comparison between the simple and compound engine for any given case, it is necessary to first compute the "annual fuel cost" of each. This should include the additional

fuel, if any, required for heating, and also the interest and depreciation charges upon the first cost. The method of doing this may be illustrated by a practical example.

The power for lighting and elevator service in an office building is to be furnished by two high-speed non-condensing engines of 100 hp each. They are both to run 12 hours per day for 300 days in the year, and the steam required for heating averages 60,000 pounds per day for 100 days. Which will be the more economical, simple engines costing $15 per hp and having a water rate of 32 pounds per hp per hour, or compound engines at $20 per hp and a water rate of 25 pounds per hour?

Let the cost of coal be $4 per ton of 2,000 pounds, and assume an evaporation of 8 pounds of steam per pound of coal in the boilers.

Then for the simple engine, the fuel cost for power will be

$$\frac{32 \times 200\ (12 \times 300) \times 4}{8 \times 2{,}000} = \$5{,}760.00$$

per year. To this must be added an interest charge of 4 per cent, and a depreciation of, say, 8 per cent on the first cost, which is $200 \times 15 \times 12 = \$360$.

The next step is to see if any additional fuel is required for heating.

The average requirements are 60,000 pounds of steam per day, or 5,000 pounds per hour. Assuming that 80 per cent of the steam delivered to the engines is available for heating in the form of exhaust, there will be $200 \times 32 \times .8 = 5{,}120$ pounds furnished in this manner, which is more than is required for heating, so that no extra charge is necessary for this purpose.

The total fuel cost for the simple engines is therefore $5{,}760 + 360 = \$6{,}120$.

Taking the case of the compound engines, all of the factors remain the same except the water rate and first cost. As the expenditure for fuel is directly proportional to the water rate of the engine, the amount in this case will be $5{,}760 \times \frac{25}{32} = \$4{,}500$.

Interest and depreciation $200 \times 20 \times .12 = \$480$.

The available exhaust for heating is $200 \times 25 \times .8 = 4{,}000$ pounds per hour, which is 1,000 pounds less than is required. If 8 pounds of steam are evaporated per pound of coal, then $1{,}000 \div 8 = 125$ pounds of coal are required per hour to provide the steam necessary for heating, over and above that furnished by the engines in the form of exhaust.

This for 1,200 hours at $4 per ton is

$$\frac{1{,}200 \times 125 \times 4}{2{,}000} = \$300.$$

From the above we find the total fuel cost to be $4.500 + 480 + 300 = \$5{,}290$ against $6,120 in the previous case, making a saving of $6,120 — $5,290 = $830 per year in favor of the compound engine.

As the compound uses less steam than the simple engine, the boiler can be reduced if the plant is a new one. Steam per hour for simple engine, $200 \times 32 = 6{,}400$ pounds. Steam per hour for compound engine, $200 \times 25 = 5{,}000$ pounds, resulting in a saving of 1,400 pounds per hour.

Assuming an approximate evaporation of 30 pounds of steam per boiler hp, a reduction of $1{,}400 \div 30 = 47$ hp can be made in the size of the boiler plant. If water-tube boilers are used at a cost of say $20 per hp, this would result in a saving of $20 \times 47 = \$940$ in the first cost, or a yearly saving of $940 \times .12 = \$112.80$, which added to $830 makes a total of $942.80 per year by the use of compound engines under the conditions stated in the problem.

This, however, is only a simple illustration of the method of computing fuel costs; other conditions might be present which would alter the result, such as excessive water rates, or increased cost of attendance for the compound engine. We have also assumed for simplicity, that both engines would operate at full load all of the time, which would probably not be the case in actual prictice.

Then again, the quantity of steam required for heating at different seasons might vary from that given in the example. However, the illustration shows the general method of procedure, and can be varied to suit existing conditions.

Compound engines have been growing in favor of late years for use in connection with heating systems, and in many cases have shown their superiority when "all-the-year-round" economy is considered. There may be a period during the coldest months when no gain is shown over the simple engine, but when the milder weather of spring and fall is considered, together with the summer months when no use can be made of the exhaust steam except for heating feed water, the economy of the compound engine becomes evident. The main point is to always operate the compound unit within its economical range; that is, from 50 per cent load to full load, as at light loads the gain falls off quite rapidly.

The best type of engine as regards speed, depends much upon the available room. In office buildings and other similar locations where floor space is valuable, the high-speed engine is used almost exclusively.

For central lighting plants in connection with public institutions, where space is not so limited, the moderate speed engine is a good type to employ.

For factory and general power work, the slow-speed engine of Corliss or similar design is generally used, being economical in the use of steam, durable, and easily cared for.

In an electric lighting plant the load is usually very light during the day and is at a maximum for a few hours only during the evening. For this reason it is very desirable, unless the power supplied is small, to have several units so arranged that as the load increases their power may be successively added as required.

The best economy in operation is obtained where large machines are used during periods of heavy loads and those of small size during light loads. While greater economy may be secured by making all the units of a different size, certain practical considerations may often lead to a different course.

The custom of many engineers is to divide the total capacity into three units, each of such size that two of them, by being overworked not exceeding 30 per cent, can do the maximum work satisfactorily This permits the withdrawal of one unit in case of accident or repairs, and besides, the three are interchangeable on the work. Their first cost is usually less, they adapt themselves better to the available space in the engine room, only one size of parts need be kept for repairs, and in case of accident the plant would not be crippled as would be the case if the units were of different size and the largest should break down at the time of heaviest loading. The size of dynamo in connection with light loads is not of so much importance as that of the engine, for the efficiency does not decrease so rapidly with under-loading.

Even at one-third load the efficiency of some dynamos is but little less than that at full load; also small dynamos are made nearly as efficient as those of larger capacity, so that it is allowable to suit their size and number to the requirements of the engines.

Direct coupling of engines and dynamos has great advantages over other methods of connecting. It is simple, compact, produces no loss of efficiency due to belting or counter-shafting, and also does away with the noise of belt-driven machines. The economy in space is of much importance in the case of office and other city buildings. With a direct connection the dynamo must run at the same speed as the engine, and since the speed of a generator is usually much higher than that of an engine, the generator must run at a comparatively slow speed, and a high-speed engine must be used.

Running a dynamo at slow speed reduces its economy somewhat, but the advantages to be gained by direct coupling often more than offsets this, and in many cases it is a necessity on account of the available floor space.

Belted dynamos are sometimes preferred in the case of small plants where there is ample room. They are also better adapted to cases where it is desired to connect them with engines already installed. If a belted machine is to be used, it is better to employ the slow-speed type as it runs cooler and with less liability of injuring the armature than those of higher speeds.

LETTERS ON PRACTICAL SUBJECTS.

BRUSH SETTING ON RECTIFIERS OF ALTERNATORS.

I herewith enclose a few notes relative to brush setting on the rectifiers of alternating-current machines. If the commutator is true and the brushes nicely fitted, there should be very little sparking, even on overload. If the commutator is not true, the brushes will be thrown into rapid vibration and considerable tension is necessary to keep them in contact with the segments. Vibration is one of the most prolific causes of sparking and usually throws the brushes bodily away from the commutator, thereby producing momentary breaks in the circuit. Sparking from this cause damages the commutator most at the positive side and the brushes most at the negative side. Since some sparking is bound to occur even if the commutator is true, it is desirable to confine it to the points where it does the least damage to the commutator, since it is more troublesome to make this true and to repair it. I have noticed that sparking at the toes of the positive brushes and at the heels of the negative brushes causes most damage to the commutator, while the reverse is true at the toes of the negative brushes and the heels of the positive brushes. Hence, it is desirable so to set the brushes as to confine the sparking to the points of least damage to the commutator. This may be done by filing the positive brushes to the usual angle and the negative brushes to a more acute angle. When this is done and the brushes are nicely fitted on the commutator and the toes of the positive brushes put in contact with an insulating strip, it will be found that the negative brushes reach over the insulating strip near them by a slight distance. That is, they have a small lead over the positive brushes and usually an eighth of an inch is sufficient. When set in this manner the sparking which exists will be confined to the toes of the negative brushes and to the heels of the positive brushes, and will be only slight. When setting the brushes in this way it is necessary for one to make certain that the polarity is right and not to give the negative brushes too much lead, as it is then possible for the positive brushes to change segments before the negative brushes have bridged segments, thus producing momentarily an open circuit and sharp static sparking over the insulating strips, and carrying arcs which char and burn the strips and also the commutator segments, usually at the corners. These precautions should be remembered and the brushes should not be too thin.

Patchogue, N. Y. Henry Mulford.

NOVEL OILING SYSTEM.

The accompanying sketches illustrate a system for oiling engines which is in use in the plant with which the writer is connected. The cylinder, *C*, is made from a piece of 14-in. steam pipe, and is 5 ft. long. The pipe is capped at both ends, the upper cap being tapped to receive the nipple and cap, *E*, the

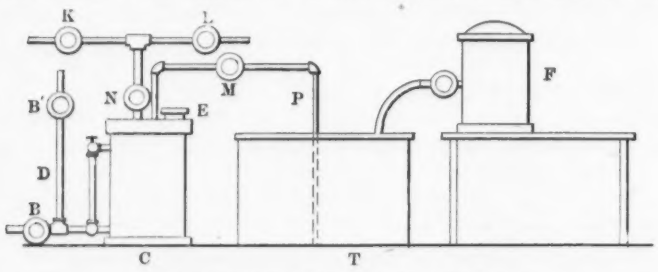


FIG. 1.—SYSTEM FOR OILING ENGINES.

valve, *M*, and pipe, *P*, also the valves *N*, *K*, *L*, and piping as shown. The cylinder is also tapped for gauge glass connections, the valves *B* and *B'* and the nipple, *D*. The tank, *T*, is intended for the lubricating oil and the pipe, *P*, extends almost to the bottom, as indicated by the dotted lines. The valve, *B'*, is connected to a water pipe. In order to fill the cylinder, *C*, with oil, the valves, *B* and *M*, are shut and the valve *B'* opened. This allows the cylinder to fill with water after which the valve, *B'*, is closed and the valves *B* and *M* opened. The water in flowing out through *B* forms a vacuum in *P* and *C*, thus causing the oil to flow from the tank, *T*, into the cylinder. The gauge glass shows how much oil comes over and when the cylinder is full or partially so, the valves, *B* and *M*, are closed and the valve, *B'*, opened. The oil in the cylinder will thereby be placed under pressure and by opening the valves *N*, *K* and *L* the oil will flow through the piping erected for the purpose to the different bear-

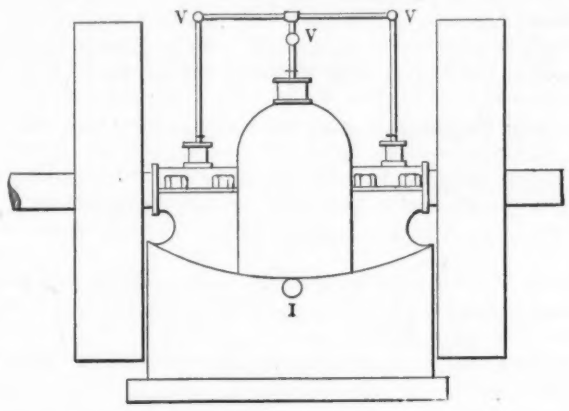


FIG. 2.—LUBRICATING CRANK PIN AND MAIN BEARINGS.

ings. Fig. 2 illustrates the method employed to lubricate the crank pin and main bearings and Fig. 3 shows how the crosshead and slides are oiled. The grooves cast in the engine frame carry the waste oil to the outlet shown at *I*. From this outlet the oil can be piped to a filter, *F*, if this is low enough for the oil to flow by gravity, otherwise the waste oil may run into a vessel fixed to the outlet, which vessel must be emptied as occasion requires. Where the oil is piped to a filter some means for cleaning the return pipe should be made. By connecting this pipe to either a water, compressed air or steam pipe this cleaning may be readily accomplished. Referring to Figs. 2 and 3, it will be noticed that the piping is run into the caps of the oil cups; but if these caps are made with an elevated ring around their periphery and a hole is drilled in each cap, the oil can drop into the recess and flow through the hole into the cup. In this way the oil cups can be maintained practically full of oil during the run. By regulating the valves marked *V* the amount of oil fed to the cups will balance the quantity discharged from them, and under all ordinary conditions it will be almost impossible to have a

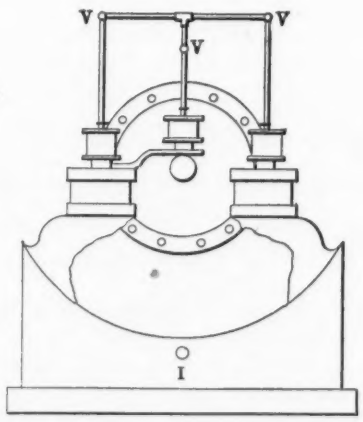


FIG. 3.—LUBRICATION OF CROSS-HEAD AND SLIDE.

hot bearing with this system. In shutting down the regulating valves can be closed; but it is easier to shut the valve, *N*, and permit the regulating valves to retain their regular feeding position. It will be noticed that as the oil is fed from the cylinder, water takes its place, and for this reason it will not be necessary to fill the cylinder with water every time it is required to fill the cylinder with oil.

New York City. William Kavanagh.

REDUCTION OF THE RATE OF COMBUSTION GIVES MORE ECONOMICAL RESULTS.

Theoretically, a high rate of combustion in the furnace of a steam boiler giving a high initial temperature together with conditions that allow the boiler to absorb much of the heat, before the stack is reached, resulting in a comparatively low final temperature, will give the most economical results, but this is not always true in practice, and in some cases there are conditions found which seem to meet these requirements, but really they do not, because the final temperature is too high.

The main object is to take as many heat units as possible out of every pound of coal and transfer them to water in the boiler, converting it into dry steam. In every case this means that the final temperature of the gases must be comparatively low or else heat here represented will go to the stack and be lost.

If we begin the operation by designing a furnace so that the rate of combustion must be high, or in other words making it necessary to burn an excessive weight of coal per square foot of grate surface per hour, we shall not secure good results unless we have heating surface enough to absorb a very large portion of the heat generated.

Failure to appreciate this fact has caused engineers to design plants where 30 or more pounds of coal are burned on each square foot of grate surface per hour, with a final temperature so high that the steel stacks are red hot above the roofs. The life of a boiler is short under such conditions, the man who fires it ten or more hours per day will not live his full time, and much coal is wasted.

Where a plant is designed so that the rate of combustion is high, and the ratio of heating to grate surface is also high there is less waste of heat, but under some conditions the practical results do not agree with the theories advanced by some engineers. One explanation of this is as follows: With a high rate of combustion ashes and clinkers collect fast, and there are plants where the old-fashioned stationary grate is used, consequently the fires must be cleaned several times per day, and during this process the fire that is being cleaned generates but little steam, hence a greater load is thrown on the other boilers which they are not always able to carry and maintain full pressure. When this is restored and the process repeated with the other boilers, the first fire is nearly ready for cleaning again, especially if the coal is not first quality.

If mechanical stokers are used, or good shaking grates under proper conditions, the result will be far different because none of the fires are laid off for cleaning purposes, but all burn steadily.

The following incident illustrates the benefits of a reduced rate of combustion: A certain plant was equipped with two large boilers having about 52 sq. ft. of grate surface under each of them, and one smaller one with about 35 sq. ft. These were forced so that it was decided to put in another large boiler with about 52 sq. ft. of grate surface to carry the same load.

The fireman said that it would not be possible for him to fire all four boilers, as three were enough. When the fourth was ready for service the engineer made this proposition: "We will start all four boilers, and if you find it more work than before, we will cut out one boiler and run the engines with three." This was tried, and the fireman found it so much easier than before that he would not consent to have the fourth boiler cut out.

Let us analyze these conditions and see what they show. There was formerly 139 sq. ft. of grate surface, and if 25 pounds of coal were burned per hour on each square foot, the total would be 3,475 pounds. After the fourth boiler was added there were 191 square feet, and if the same total was burned the rate per square foot per hour would be reduced to 17 pounds. But there was a remarkable decrease in the total burned, amounting to more than 25 per cent, bringing it down to 2,607 pounds, and when this is divided by 191 the rate is found to be 13.6 pounds. While this is not a closely calculated result, it is practically correct, and shows that under these conditions a rate of 13.6 pounds is much more economical than 25 pounds, and there are many other plants in which the same improvement could be made. It will be noted that in this case the heating surface was also increased.

In the face of such proof as this it is not reasonable for theoretical engineers to maintain that a high rate of combustion is more economical than a low rate, and they cannot convince a firm after they have had the above described experience, nor those engineers who are familiar with the facts in this and other cases.

SANDUSKY, O. GEO. MCARTHUR.

STORAGE BATTERIES ON SHIPBOARD.

The practice of locating a storage battery in any old out-of-the-way place on yachts has proven to be a very expensive practice in the long run. Just why a storage battery should be considered a collection of junk, to be stored in any unused portion of a ship's hold, has never been explained, but may be due to the use of the word "storage" as differentiating the battery from the primary type and as the popular conception of the word "storage" means a place, out of sight, where a thing may be stored, may explain the "shanghieing" of storage batteries to the lowest and most ill-ventilated spot on the vessel.

A battery room on shipboard should be lead-lined, if possible, or given several coats of asphaltum paint; well ventilated and the cells so arranged that ready access might be had to any particular cell in need of attention or repair. If arranged in double tiers there should be sufficient head room between the tiers to permit the removal of the elements of the top or bottom cells without disturbing the cell, or adjacent cells. As the acid fumes gather on the walls and drip to the floor, a suitable system of drainage, through lead pipe, should be provided and the aisles sprinkled with bicarbonate of soda about once a week, to neutralize the effects of the electrolyte, which may be precipitated to the floor, in the process of charging.

The equipment usually consists of a charging board on which is mounted an automatic cut-out switch, which is supposed to open the charging circuit when the battery has been fully charged, but like all mechanical appliances, that device is not infallible and may sometimes fail to operate with the result that the battery is overcharged and possibly damaged. There are well-defined indications of a charged battery which every engineer in charge of such a plant should understand, that he may obtain the best results from the battery under his care, which is just as important as the steam equipment, at certain times.

A table of the normal rate of charge and discharge of a particular battery is usually furnished by the manufacturer, so that an approximate idea of the amount of current discharged from or charged into a battery may be determined, if instruments are watched; but when charging the result should not be left to a supposition and may be determined by an inspection of the cells. If the electrolyte is of a milky hue and the electrolyte gasing or boiling freely, giving off large bubbles, which explode with a loud report when ignited, it may be assumed that the battery is fully charged.

An excellent method of keeping a record of the discharge and charging of a battery is a recording voltmeter, connected across the end cells of the main battery. Suppose the battery in question consists of sixty cells on each side, fifty in the main battery and ten regulating cells, then the normal voltage, when fully charged, across the fifty main battery cells, should be 125 volts, under the normal rate of charge. That voltage will decrease to about 110 volts when the charge is stopped; an average of 2.2 volts per cell, which is the average voltage of a fully charged cell, in good condition.

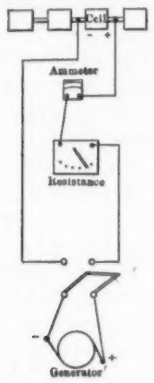
To maintain a battery in good condition, it is necessary to work it at regular intervals. If it is allowed to remain idle a chemical process termed "sulphating" takes place, forming a hard crust of non-conducting material on the surface of the plates, which seriously reduces the capacity of the cells affected.

When such a condition exists it may be remedied by discharging the cells at their one-hour rate and then immediately recharging them. It may be necessary to repeat the process several times to work off all the sulphate, but will eventually cure the "sick" cells and restore them to their normal capacity. Another cause of falling off in capacity is the formation of local short-circuits between plates by lead particles which may lodge there, or by buckled plates caused by an excessive overcharge. If from the first cause a thin piece of wood may be passed between the

plates, thus removing the obstructions, if from the second cause, the plates must be removed and straightened, which should be attempted only by one who is thoroughly familiar with such work.

It is important that the electrolyte should cover the plates and that distilled water only be used for filling the cells when the electrolyte has fallen below the top of the plates. In addition to the regular filling of the cells a specific gravity reading should be taken on all cells, once a month, when the battery is fully charged, and immediately after it has been charged. That reading should indicate a density of from 1,190 to 1,200 as indicated on the scale of the hydrometer supplied by the manufacturer. If the hydrometer indicates less than 1,190, the cell requires more acid until the density reading reaches that figure.

In conjunction with the gasing and appearance of the electrolyte formerly mentioned, the hydrometer may be used as an indicator of the battery's condition under charge. When the density reading ceases to rise the battery is fully charged, but as the capacity of various cells may vary from local causes, an inspection of the



CHARGING A SLOW CELL.

cells when under charge is the most satisfactory method, as the "slow" cells may then be instantly detected by the lessened flow of electrolyte from the center toward both ends of the tank and the smaller gas bubbles, as compared with those of the other cells. A "slow" cell requires immediate attention and as a rule should be given a separate charge, which involves the direct connection of the cell in question, to the charging board or generator by suitable cables, through a resistance box and ammeter, as shown in the illustration herewith. The normal rate of charging current is then sent through the cell until the appearance and flow of the electrolyte indicates that the cell is fully charged. A slight overcharge is usually necessary to restore the cell.

Care must be used when connecting the cables that the positive cable is connected to the positive side of the cell, or the cell will be reversed and in much worse condition than it was before.

In addition to the regular charging, an overcharge should be given a battery about once a month. That will keep slightly backward cells in condition and will not injure the good cells. On such occasions, after the automatic switch has opened, it may be tied or blocked in and the charge, at normal rate, be continued for fifteen or twenty minutes longer.

If a recording voltmeter is used the charged condition of the battery is indicated when the voltage ceases to rise and the line on the chart commences to run straight. The charge should be kept on for at least five minutes after that line has become steady, and in the case of the regular overcharge for fifteen or twenty minutes. When the battery is to be laid up for the winter it should be fully charged, the electrolyte removed from the tanks and the plates stored in racks in a dry place. The plates should never be laid on their sides, but stored on end. In the spring the plates may be placed in the cells, covered with electrolyte and given an hour's overcharge, in addition to a regular charge, and the battery will be ready for service.

New York City. W. T. Fernandez.

LINING A STEAM ENGINE.

When I was a young engineer I learned that the proper way to line up a horizontal engine is to take off the cylinder head, remove the piston and rod, take out the wrist pin if possible, and take off the connecting rod. If it is not practical to remove the wrist pin take out the entire crosshead. This makes it possible to draw a line from the exact center at the head end through the stuffing box at the crank end, and extend it beyond the crank shaft. If it passed through the center of the hole made for the piston rod, when the cross-head was at either end of the guides the cross-head and guides were sure to be in line.

A line was then drawn at right angles to this line and if the crank shaft was parallel to it the engine was said to be in line. If the crosshead had been removed, calipers were applied to the line at both ends of the guides and if they were parallel to the line there could be no mistake about it.

At the present time other methods are used, and it appears as if they are not all worthy of approval. In order to save the trouble of removing the piston, the cylinder head is taken off and a line set at a certain distance from the center of the cylinder at the head end. This line is set at an equal distance from the center of the piston rod at the stuffing box and extended beyond the crank shaft. The crosshead is then moved as far out as possible, and if the rod is then found parallel to the line, the guides are said to be in line.

The crank is placed on one center and the distance from the face of it near the pin to the line measured and noted. Turning the crank to the opposite center the same measurement is taken and if the two agree the crank shaft is in line.

If the work is done very carefully this plan may give good results, but there is much chance for error and it does not take much sometimes to make a bad pound in an engine.

Another plan which is much more liable to error is used by a certain man who takes contracts for repairing engines in this vicinity. He claims that the screw put in to hold the false cylinder head in place is always located at the exact center of the cylinder, therefore he makes an attempt to find the center of this screw, but as there is no center mark in it, he cannot be sure of this point. Measuring off a certain distance from this screw he locates a line and draws it parallel to the outside of the guides. If there is a disk crank on the shaft he measures from the face of it at one side to the line and repeats the measurement at the other side. If they agree he is satisfied that the crank shaft is in line.

There is one point in favor of this plan as it does not take long to do it, but that is the only good feature it possesses. We cannot be sure that the above mentioned screw is in the exact center of the false cylinder head, and there is absolutely no means of telling where the center of this screw is, therefore if an attempt is made to set a line by it nobody knows whether it is right or not.

If this line is parallel to the outer edge of the guides, it does not prove that the crosshead travels in a direct line with the center of the cylinder. If we have an engine that has been used for a long time and there is a knock in it, we may think that the guides are worn unevenly so that the crosshead is thrown out of line. Drawing a line parallel to the outer edge of the guides where they are not, and never can be worn by the crosshead as it travels to and fro, gives no information concerning the position of the crosshead at different parts of the stroke. Such proceedings are misleading because they give the superintendent the idea that an investigation has been made concerning the cause of trouble, when in reality nothing of the kind has been done.

The engineer may think that the crank shaft is out of line, causing a knock, but measurements taken from this line to opposite edges of the disk crank exactly agree, thus proving to the casual observer that the shaft is in line, but still it may not be in its proper place.

The "trouble man" sent out by a firm that has built and sold many engines, informs me that it is not at all safe to go by the face of the disc crank, as they do not warrant them to be turned true.

It seems to me that if an engine is to be lined at all it should be done thoroughly and well, as otherwise the results cannot be depended upon, and I have no confidence in any method which does not include drawing a small braided line through the exact center of the cylinder, passing between the guides so that accurate measurements can be taken.

The crank, whether it is of the disk type or otherwise, should be turned until the pin just touches the line, and very exact measurements taken to determine the distance from it to the crank, also to the head of the pin. It is not necessary that this line shall be in the exact center of the pin, but when the crank is turned nearly through one-half revolution until the pin barely touches the line again, measurements taken now should agree exactly with those above mentioned. If they do not, the crank shaft is not in line, and it should be adjusted until these measurements agree exactly.

Many Corliss engines are made so that when lost motion due to wear in the main bearing is taken up, it gradually moves this end of the crank shaft towards the cylinder, thus throwing the shaft out of line. The process is so slow that some engineers do not think of this point, but it is worthy of attention.

After a Corliss or any other type of engine has been so adjusted several times, the adjusting screws should be loosened and the shaft moved away from the cylinder until it is possible to put one or two thin liners back of the quarter box. This may be done by placing the crank pin just above the inside center and admitting steam to the head end of the cylinder.

Liners may be added until the crank shaft is exactly in line, but measures should be taken to find out if this will cause the piston to strike the cylinder head when the crank passes the outer center, before the engine is started up for regular service. Although these liners may only bring the shaft back into its original place, still it may be dangerous because the connecting rod may have been designed so that wear on the crank pin and wrist pin boxes draws the piston forward, and it may be so near the cylinder head that putting liners back of the quarter box will make it strike. The remedy is to put liners behind boxes at one or both ends of the connecting rod.

PHILADELPHIA, PA. CHAS. WILSON.

OPERATION AND CARE OF PRODUCER GAS PLANTS.

Having had abundant opportunity during the past few months to study at close range the operation and care of producer gas engines and producer gas apparatus, my experiences with this type of prime-mover and the gas generators may be of some interest to your readers. Our plant consists of two Crossley engines rated at 610 hp each; two 9-ft. by 16-ft. gas producers; one 6-ft. by 20-ft. economizer, a wet scrubber, a dry scrubber, water gas and producer gas holders. The sketch herewith shows the arrangement of the apparatus.

The producers are lined throughout with fire brick and provision is made for cleaning the ash pit and fires through doors in the side. The grates are made of fire clay and formed in the shape of a cone. Fuel is fed to the producers from the charging floor through doors *A, B* at the top. Two water-cooled valves, *C, D,* are connected between the producers and economizer and form a path for the gases from the producers to the scrubber. These valves are operated from the charging floor above as indicated. Small pipes are run from a manifold to the ash pit and also to the top of the producers for use in making water gas. The bottom of the economizer where the gases enter is lined with fire brick. A 14-in. pipe connects the generators which is of service when making water gas. When making producer gas the direction of the gases is down through the fire, up through the economizer, then through pipe *E* to the bottom of the scrubber. On entering the scrubber the gases are constrained to take a downward course and in order to ascend to the top must pass under a submerged diaphragm as shown. The gases are separated from the carbon to some extent and are distributed to all parts of the scrubber by the diaphragm. Grids are placed inside of the scrubber, the three lower sets being covered with crushed rock to a depth of 14 in. The fourth set of grids is covered with 17 in. of coke and the upper grids are filled with excelsior. The extension top, *F,* is also filled with excelsior and

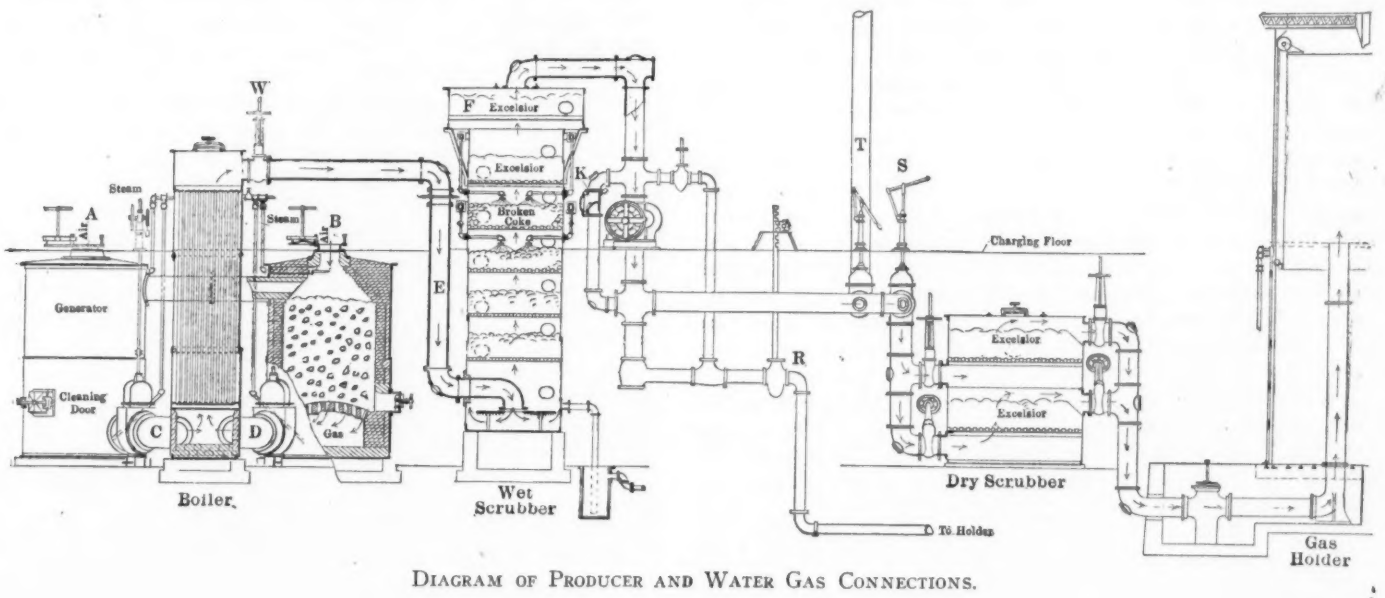


DIAGRAM OF PRODUCER AND WATER GAS CONNECTIONS.

having no connection with the water sprays, is termed the dry end of the wet scrubber. The three lower grids are made of cast iron while the two upper grids are made of wood.

In their upward course the gases pass through the crushed stone and are sprayed with water in order to separate the carbon and soot. These latter are carried to the bottom of the scrubber by water and gravity and find their way into the drain shown. The gases continue upward and pass through the excelsior at the top. This completes the work of the wet scrubber and the gases are forced through a dry scrubber which is filled with sawdust, excelsior and dirty waste. The latter is an excellent collector of soot and carbon and upon examination the writer has found that fully 75 per cent of the carbon that passes over from the wet scrubber is caught by the dirty waste, while 25 per cent is caught by the sawdust and excelsior; very little soot finds its way to the engines or gas mains. Provision is made for by-passing the dry scrubber, and drips are provided to collect any water entering the pipe with the gas.

In starting a new plant great care must be exercised to drive out all air in the gas holders and gas mains, otherwise if sufficient air is present it will combine with the gas and form an explosive mixture. A slow fire should be kept in the producers for at least four days in order to dry out the brick. The exhauster may then be started and the gases purged. This is done by opening the purge stack valve and closing the gas main valves, *S* and *R*. After two hours the holders may be filled with gas by opening the valve *S* and closing the valve *T*. When the producer gas holder is filled the water gas holder should also be filled in a manner explained later. Both holders should then be lowered by opening the valve in the purge stack and the valve *S* for the producer gas. This latter valve should then be closed

and the water gas valve, *R*, opened. When this operation has been repeated at least three times the two holders can be filled and left so. It is, of course, taken for granted that both holders were previously filled with water up to the overflow. A connection must be provided at the ends of the gas mains so that by opening a valve the air will be driven out, and all the cocks on the gas bags or engines must be left open and the gases tested before the engines are started. A good way to test the gas is to hold a 1¼-in. pipe 2 ft. long and capped at one end, over the gas escaping from the gas main. A certain amount of gas will thus enter the pipe. This should be kept from escaping by holding the hand against the open end of the pipe and an assistant may light a match and apply it to the gas the instant the hand is removed. If there is a slight explosion the purging of the gas should continue and the test should again be made until no explosion takes place. The cocks and valves may then be closed and the engines started. The same test should be applied when the gas holders are emptied of water for repairs.

When the fires are to be cleaned the valve, *W*, should be closed and as soon as the cleaning is completed the exhaust started and the valve opened again, the gases being well purged. When the scrubbers are to be cleaned the valves should be closed on both sides, and when the dry scrubber is to be cleaned its valves should be closed and as soon as the work is done the pipe purged by opening the purge valve, *T*, and the valve, *S*. This will cause the gasometer to drop and drive out the air in the pipes. One-inch pipe connections are made to the gas mains between the gas holder and engine and also near the valves in the producer gas gain and near the valve in the water gas main. These pipes should extend through to the charging floor and the gases from all kept burning. The pipes are reduced to ¼ in. at the blaze and by this means the richness of the gases may be determined. The operator can tell by the color of the blaze how much water gas to let in, or in other words compound the mixture.

Water gas is made somewhat differently from producer gas, but takes the same course through the scrubbers. The doors at the top of the producers are closed air tight. The valve, *C*, between the producer and economizer is closed; the steam valve and valve *R* are opened and valve *S* closed. The jet of steam drives the gases up through the fire and over to the other producer. The gases pass down through the fire of the latter producer and pass out at the bottom through valve *D* to the economizer and thence to the scrubber and to the water gas holder. When the holder is filled the steam is shut off and the charging door carefully opened. Valve *S* is opened and valve *R* closed. The valve *C* is then opened and producer gas is again made. The next run of water gas is made in a similar manner. While water gas is being made the exhauster is allowed to run and the by-pass valve, *K*, is opened, the gases making a circuit through the pipe before and after the steam valve is opened. If the check valve *K* were left closed after the charge doors were closed the engine that drives the exhauster would stop on account of the vacuum formed in the producers.

Cambridge, Mass. W. A. Dow.

SLATE ROOF DESTROYED BY LIGHTNING.

At the suggestion of one of your readers I send you the following: During a thunder storm in an outlying village on the evening of August 22, a fuse in connection with the electric light wiring of a dwelling was burned out, and of course the lamps were extinguished. In the attic where the fuse was located the smell of sulphur was noticed, but no evidence of fire in the building could be found. The roof of the house was covered with black slate. A day or two after the storm a few pieces of slate were found in the yards near the house and observation quickly revealed the fact that they had come from the roof of the house near one of the valleys and at the ridge of the roof. The inference was immediately drawn that lightning must have struck the house. A slater was engaged to repair the damage and after going on the roof he reported that all the slate on the roof except on one section facing north was so badly burned that it could not be worked upon without crumbling to powder. The ridges of the roof are covered with metal strips a few feet in length and the overlapping ends of these on one of the ridges were found to be loosened up. Except as stated above, no marks of lightning were found on the house; no boards, rafters or timbers splintered—nothing by which to determine the path of the electricity. It would be of great interest to at least some of your readers to know whether the lightning was the cause of the condition of the slate as is claimed.

Utica, N. Y. G. A. Geer.

[The odor noticed was undoubtedly that of ozone and not sulphur and would indicate that lightning had blown the fuse. It is not uncommon for slate to be thrown some distance by lightning discharges, and while it is possible that the heat of the discharge was so intense as to destroy the structure of the slate, we have never heard of the phenomenon before.—Editors.]

VARIATIONS IN WATER LEVEL.

Some time ago I heard the engineer of a plant containing two horizontal tubular boilers tell his fireman to watch the water level in both of them closely and change the feed water valves whenever they needed it, and explained to him that the boiler under which the best fire is maintained always takes feed water slower than the other, hence the level falls faster with both feed valves open.

As many others deem this a correct theory, I wish to protest, as such a view of the case is not right. When a pair of horizontal boilers are set on the same level, discharge steam into a main pipe that is common to both of them and are fed through a pipe, the outlets from which are alike, the same amount of water will go into both of them. I do not claim that the water level will remain the same in both, as it will not, but changes are due to the fact that if a better fire is kept under one than the other, more water will be evaporated in that boiler, and this explains the whole matter.

Several years ago I was in charge of a plant containing two horizontal boilers under which shavings were burned. The fireman had to change the feed valves frequently in order to keep the water levels anywhere near alike. One day I talked with him on the subject and explained that whenever the water level began to rise in one boiler it was evidence that he had a poor fire under it; therefore, instead of shutting the feed valve he should build a better fire in that furnace, which was an easy matter, as the firing was done by hand. He readily grasped the idea and afterwards very seldom changed those feed valves, but made each boiler do its share of the work. A power pump was used which gave a uniform supply of water. It was regulated by means of a small pipe, which allowed some of the water to flow from the discharge back into the suction pipe. By changing a valve in it occasionally it was never necessary to stop the pump while the engine was running.

In another plant with which I am familiar the water level in different boilers cannot be properly maintained as above described, because three of them are horizontal and one is vertical; consequently the water level is much higher in the latter than the former. With a uniform steam pressure in all of these boilers, there is about 4 pounds more pressure in the feed water pipe of the vertical than in the others, and this makes it necessary to change the feed valves frequently, because they will not feed evenly when there is so much difference in pressure. A separate steam pump could be provided for this boiler, but that would require as much attention as the higher water level now calls for, hence it would be no improvement over present conditions.

Where boilers are on the same floor it is an easy matter to install feed-water regulators that will keep the water level in all of them, but how could it be accomplished in this case while using a power pump? If all of the boilers needed water all of the regulator valves would open, but only a little would go to the vertical boiler against the extra pressure. When the horizontal boilers were supplied, the regulator valves would close and send water to the vertical, but would this be done soon enough to prevent it from being burned? Perhaps some reader who is operating a plant of this kind will explain how a good feed-water regulator operates, as it certainly would be a valuable time saver if it worked well.

New York City. W. H. Johnson.

TROUBLES DUE TO CARELESSNESS.

It does not pay to be careless. It matters not whether a man be station manager, designer or dynamo tender; carelessness usually brings disaster. Want of a piece of tape in the wiring of a moving picture machine led to what might have been a serious fire. It requires about 25 amp. to properly operate one of these machines, and when that amount of electricity found its way beside a carelessly-placed piece of tape, a short-circuit resulted, burning the operator severely and doing some damage to the building.

Another instance of what can only be called stupidity was shown in installing drop lamps from the ceiling of a factory. The porcelain rosettes were of the cheapest variety, the cap being screwed on with two wood screws and the wiring attached directly to the caps by means of wood screws. In this case, instead of properly securing the base by means of two wood screws, and then putting on the cap with two more screws, the careless worker put in only two screws, and made them hold not only the wiring, but the base and cap also. The result was that the woodwork shrunk during the seasoning progress, the wires became loose and a little arc sprung across one day and set fire to the woodwork. Luckily, the fire was discovered before it had gotten much of a start, or there would have been another "fire caused by defective wiring."

A 15-hp induction motor was sent to a shop to have three burned-out coils replaced in the stator. The coils were built up with No. 15 wire and, not having any wire of this size the repairman used No. 14 wire instead, the result being that the wire being a little larger than it should be, the wire space was badly crowded. Some of the insulation in the wire spaces adjacent to the burned-out coils had been considerably scorched during the burn-out and were, therefore, very tender and easily broken. The repairman did not make allowance for this fact, and, after the coils had been mended, or replaced by new ones, it was found that two other coils on either side of the burn-out had been so damaged during the mending operation that the insulation had broken down and these coils had to be replaced also. This extra work would have been avoided had the workman exercised due care in making the first repairs.

A 3-hp motor, of the induction type, was found to be weak in starting, but would run fairly well after being once started. Still it gave out that piteous whine which tells that it was running on two phases instead of three. This motor had been cut in across the terminals just outside the switch, of a 75-hp motor of the same type, and a three-plug fuse box had been placed in the line close to the switch above noted. The fuse plugs were tested by screwing them one at a time in a circuit containing a single lamp. It was found that the lamp burned brightly with each of the fuse plugs in that circuit, therefore it was assumed that the fuses must be good ones. But the two-phase whine still continued, and it was determined to test the fuse board and see if there was any trouble there. To this end one of the fuse plugs was unscrewed, and the motor switch thrown in. The motor refused to start and there was no "two-phase whine." A bridge was formed across the fuse box with a piece of copper wire, connecting the phase wire the same as if the fuse plug was in place. Then when the switch was thrown in again the motor started, but with the old "two-phase whine," which showed that one phase was still out of business.

Proof having thus been established that one wire at least, connected all right through the fuse box, the bridge wire was removed, the fuse plug replaced and the next wire made the subject of inquiry. Here the same thing was found, the motor "limped" when there was either fuse plug or bridge wire in use as a connection across the fuse board. This demonstrated that two of the three wires, at least, were all right, and, if trouble existed in the fuse block, it must surely be in the third connection.

Upon removing the fuse plug from this wire and throwing the motor switch, the old "whine" at once started. Upon applying the bridge wire across the terminals of the third wire on the fuse board, the motor at once started up at full speed, and the "whine" had disappeared altogether. At last the trouble had been located within the limits of one of the lines on the three-fuse block. A close study was made of the block, a number of fuses known to be good were tried, but always with negative results. A connection was made in the screw socket with a screwdriver, and the motor went along all right, showing that nothing at all was the matter with the socket or its wire connections.

But the screw fuse plugs would not work, and a permanent wire was connected around the fuse block, cutting out the defective fuse socket, and permitting the motor to run with only two, in place of three, fuses in the three lines of wire. The first time the pump which was driven by that particular motor was stopped, the fuse board was disconnected and taken down from its position and thoroughly inspected. Then the cause of the trouble was discovered.

When the fuse plug was screwed into its socket a piece of insulating tape happened to get caught on the plug and was screwed into the socket. When the plug was withdrawn the tape remained in the thread of the socket, and, being on the near side of a thread cavity, was necessarily invisible to the eye looking into the socket. When a plug was screwed in the piece of tape prevented the plug from going quite deep enough to make the necessary contact. At the same time the fuse plug screwed in so tightly that each person who tried it thought that the plug had gone home to its proper bearing in the socket, when really it was 1/32 of an inch short of making its proper contact. Once the tape was removed, everything went all right.

Another instance of carelessness—this time on the part of the operator—which led to a little blaze in a factory, and which, as too often is the case, was erroneously charged up to "a defective electric wire." A three-pole, single-throw knife switch was used by the fireman for starting the little motor which operated a deep well pump. In some manner the man had left the switch nearly but not quite closed. Two of the poles were quite closed, the third had closed enough to barely touch, and then, failing to enter, had sprung back just enough so that daylight could barely be seen between the blade and its socket.

The result was that an arc had been drawn between the two parts of the switch, which melted the copper switch, and gave off enough heat that finally the wood behind the switchboard ignited. A lively blaze was running up the post which carried the switch and its half dozen wires, when the fireman happened to see it.

Carelessness does not crop out exclusively in electrical matters. All departments are full of it, and it is a constant fight of every employer to keep his men tuned up to a pitch which will prevent them from being expensively careless. The fireman in charge of the boilers has his share of the disease—sometimes he has more than his share—and lets valves go unpacked until a dollar's worth of steam leaks out around a valve stem every 24 hours. Again, the ashes are allowed to accumulate in the ash-pit until a set of grate bars is ruined six months ahead of their time. Again, it is a lot of coal shaken through the grate bars through careless cleaning of the fires. I have seen some firemen who would waste the worth of their wages through carelessness of this kind, and do it seemingly without knowing that they were wasteful.

Perhaps the largest waste in the fire room is in keeping the furnace doors and the damper open during the act of firing. It takes but a couple of seconds to close a damper, and as many more seconds to open it. Sometimes this is neglected through laziness, but more often it is pure carelessness, or neglect. A furnace, especially when being forced a little, is very easily influenced by cold air entering the fire box and striking against the shell plates. With a good recording gauge connected to the steam pipe, it is easy to trace in the record line every time the furnace door is left open with the damper open.

One of the worst pieces of carelessness that foremen have to contend with is the habit of workmen of taking needless risks in their work among the machines. Familiarity breeds contempt very quickly when men are constantly employed around machinery. Seemingly the greater the actual danger, the more careless the men become. To work without gloves, while cleaning a knife switch when closed on 400 volts and 200 amp. is something which seemingly no sane man would do, but such is usually the case.

BOISE, IDAHO. JAMES F. HOBART.

QUESTIONS AND ANSWERS.

We will be obliged if you will advise us what effect, if any, electric light wires have on a tree to which they are attached? W. T. A. M. Co

With good construction the wires would have no effect whatever. Any leakage from the line would have a tendency to kill the tree; but electric light companies take all precautions to avoid any leakage, since this means a constant source of loss.

Is it possible to test the polarity of a dynamo by means of an arc lamp? S. T.

Yes. Connect the arc lamp properly in circuit and let it burn for a minute or two. Then switch it out. The positive terminal is that connected to the carbon which remains hottest. This carbon will glow for a short while after the current is switched off.

A 2,000-volt transformer with a ratio of 20 to 1 feeds a number of 110-volt lamps on the secondary circuit. The transformer is single-phase. What change will be necessary to obtain 110 volts from the secondary instead of 100 volts as at present. J. C.

Remove some of the winding from the primary coils. The core of the transformer will become somewhat hotter because of this and the efficiency will be lessened.

We are using the electro-galvanizing process for depositing a zinc coating on ornamental frames for window screens and contemplate adding a further electro-deposited coating of copper in order that the frames may be given an attractive finish. Would galvanic action be liable to result that would be detrimental to the protective coating? S. S. Co.

Electrolytic action might take place in the presence of salt water or any exciting agency which would result in the dissolution of the zinc. In plating copper, however, it is not necessary to have a zinc base, as the copper can be easily deposited directly.

Kindly tell me the best and the cheapest way to operate a 110-volt, direct-current motor on a 500-volt, direct-current circuit. The motor is intended for operating light machinery and the only source of supply is the 500-volt circuit. T. D. H.

It will be better and cheaper for you to sell the 110-volt motor and purchase a 500-volt motor. The 110-volt motor can be operated from a 500-volt circuit by connecting a resistance across the circuit and tapping off from this to obtain 110 volts. This, however, would be a very inefficient method of supplying the motor.

A four-pole, 125-volt, 2-kw, shunt-wound exciter for an alternator refused to build up after a fuse in the main circuit (inside one field connection) had blown. I suppose the kick affected the field. But will you please tell me why it picked up when I put a low resistance across the brushes for an instant. If it were series or compound wound, I could understand it, but the main wires went without a break to the field coils of the alternator. H. M. R.

Short-circuiting the brushes through a low resistance caused the magnetism of the armature to help the field pick up. This method is sometimes used on a machine which refused to build up its field.

The power factor of a 500-volt, three-phase motor is .90, and at full load the motor takes 25 hp from the line; what will be the full load current on each wire? H. L. P.

The full load current on the line wire of a three-phase circuit feeding the motor, assuming that the efficiency is 100 per cent, is 23.9 amp. This value is obtained by means of the formula:

$$I = \frac{\textit{Horse-power} \times 746}{\sqrt{3} \times \textit{voltage} \times \textit{efficiency} \times \textit{power factor}}.$$

How can I readily determine the regulation of a transformer? S. S.

The regulation of a transformer is the ratio of the rise of secondary terminal voltage from full load to no load at constant primary impressed terminal voltage, to the secondary terminal voltage; and is expressed in percentage of the full load value of potential. Therefore, connect the transformer to a circuit of the required voltage and frequency and load the secondary with lamps or a water rheostat. The primary voltage and frequency being kept constant, note the increase in secondary terminal voltage from full load to no load.

Is it necessary in connecting various makes of transformer in parallel, to test the connections so that one will not be short-circuited on the other? J. M.

What is known as the polarity test should be applied. The polarity may be determined by taking a standard transformer known to have correct polarity and having the same ratio as the test transformer and connecting the primaries and secondaries in parallel, placing a fuse in series with the secondaries. When voltage is applied to the primaries no current will flow in the secondary circuit if the polarities of both are alike, and the fuse will remain intact. If the transformers are of opposite polarity the connection will short-circuit the one transformer on the other and the fuse will blow.

I have charge of an electric light company in Idaho which obtains electricity over a 10-mile transmission line. The voltage is 11,000, three-phase, and we step this down to 2,200 for street distribution and to 220 volts for motor service. We have an auxiliary steam plant which we use in case of accident to the transmission circuits, and use a triple-pole double-throw switch on the switchboard for throwing the load on the transmission line or the generator. When the transmission line is shut down and we throw over the load to the generator, however, all the three-phase motors on the line run backwards. We have transposed the wires but the motors still run in the reverse direction. Why does not the reversal of the wires cause the motors to run in the right direction? B. F. K.

We are of the opinion that in transposing the circuits, what appeared to be a single transposition was in reality a double transposition. If you will make the transposition at the switch by changing the position of two wires you will find that the direction of rotation of the motors will be reversed.

On account of the fact that the total core loss in a transformer operating on 133 cycles is 25 per cent less than the total core loss on 60 cycles for the same voltage, can a 60-cycle transformer be operated on 133-cycle circuits with 33 per cent greater output than the rated capacity on 60 cycles? H. C.

While the iron loss is as stated above, the copper loss with any given load is the same for both frequencies. Therefore, on 133-cycle circuits the load can be increased until the increase in copper loss is equal to the decrease in iron loss. The total losses and therefore the heating effect will then be practically the same on 133 as on 60 cycles. If the transformer was originally designed to give maximum efficiency at three-quarter load, then at normal full load the copper loss would be 16/9 of the iron loss. The total loss would, therefore, be 16/9 + 9/9, or 25/9 as large as the iron loss. A decrease of 25 per cent in the iron loss by changing the frequency would permit the copper loss to be increased from 16/9 to 18.25/9; or the current could be increased by 7 per cent. If the transformer were designed to give maximum efficiency at full load, which is seldom the case, this value would be increased to 12 per cent.

Why is it that in a Thomson watt-hour meter which is said to be a direct-current separately excited motor with armature on constant potential, the heavier the current the stronger is the field and the faster goes the meter? If a shunt motor has its speed decreased under certain conditions with an increase of field strength, why should not the meter do the same? T. B.

The torque in a direct-current motor is proportional to the strength of the field and the strength of the current in the armature, and the speed is proportional to the torque which it exerts. With a motor such as is used for power purposes, weakening of the field strength reduces the back e.m.f. of the armature, thereby permitting more current to flow in the armature, and though the actual torque effect of the field is thus weakened, that of the armature due to the increase of current more than compensates for this loss, and the result is a higher speed. The Thomson meter is built with a very high resistance armature circuit, and operates at a very low speed, so that the back e.m.f. generated by the armature is negligible, compared with the IR drop in the armature circuit. Consequently when the field strength of the stationary field is reduced, the armature current remains practically the same. The result is that as the torque due to the armature is the same and that due to the field is less with the reduced field current, the aggregate torque and consequently the speed is reduced in proportion to the field strength and cannot be otherwise. Where the potential is so great that it would be impracticable to wind an armature of sufficiently high resistance to render the back e.m.f. negligible in comparison with the IR drop, an external resistance is used in series with the armature.

CENTRAL STATION SALE OF CURRENT

New Business and Advertising at the Michigan Convention.

Considerable attention was given to the conduct of new business campaigns at the convention of the Michigan Electric Association at Grand Rapids, October 10 to 12. The only formal paper on the subject presented by a central station man was that on "New Business and Advertising," by Mr. D. B. South, of Sault Ste. Marie. He cited the fact that a couple of years since the number of lighting companies using advertising as a medium for increasing their business was limited to a bare twenty in the United States. The merchant who expects to do only the business that comes to him unsolicited and without effort on his part to secure, soon files his petition in bankruptcy. Because there are fewer lighting companies than dry goods stores is no reason why modern commercial methods of the aggressive type, as regards securing new business, should not be applied to the electric business. The opportunities of the smaller companies especially of securing new business really seem greater than those of the companies of the larger cities. The lighting company in a small Illinois town where Mr. South spent his vacation this summer is lighting less than 25 per cent of the business houses of the town. The manager said he had never had occasion to use any advertising yet. A lighting company in the State of Maine carried a small advertisement in a local newspaper for some two years without changing it. He could not conceive that under any circumstance a newspaper reader ever read that advertisement the second time. He personally knew of a similar instance, near by, where a lighting company carried a short newspaper advertisement for over three years without changing its wording in the slightest particular, and that announcement was the sum total of that company's effort to secure new or more business.

This condition is not a normal one, and it would seem that if we are going to get into the game of business getting—either new or more—we should start an advertising campaign as all live merchants do. To get this new business we will have to be liberal, as we can well afford it when it is quite likely that for every dollar expended in this direction our return shall be at least two.

Advertising is of an educational nature and in our business education is of the greatest possible moment, as it is with all public service corporations. In an advertisement of a breakfast food we are told of its ingredients, its method of manufacture, the process of packing it and the effect it produces on the various organs of the body. Of a piece of furniture, we are told of the kind of wood used, where it is found, how it is made—in fact everything concerning it, until we have a fair general idea of the cabinetmaker's art gained from a mere perusal of a cleverly written advertisement. As we should be particularly careful to make plain to all consumers and prospective consumers of electricity the methods of rating, reading meters, etc., advertisements designed to remove from the public mind the false impression that we have anything to conceal in the electrical business, should be continuously used in the start of an advertising campaign. The whole proposition should be put before the public in a convincing manner and left for them to accept or reject only when the best has been said. There is no reason why the methods affecting other lines cannot well be applied to the business of selling electricity.

The following illustration of this point is an advertisement that was first used by a lighting company in Wisconsin, some changes having been made in the original to fit local conditions at the Soo, and one they thought so well of that they increased their newspaper space and permitted it to run for a period of several weeks this summer with good effect. They also had a large number of copies printed and are mailing them out with monthly bills with the objective point in view of impressing upon customers' minds something about the cost in good American dollars of supplying them the illumination they get from a mere snap of the switch. They believe that the facts set forth are stated in such manner as to make plain to every one who takes time to read the part of the business which has heretofore been the most difficult for the consumer to understand. Most consumers reading the following will clearly understand one of the most vital points of the business, and which has heretofore been the most obscure. He had been told by customers that they had gained a much better idea of the company's methods than had been held by them before seeing this piece of instructive matter. The advertisement is as follows:

THE COST OF MAKING ELECTRICITY.

"It is unfortunate that electricity cannot be put up in boxes and bottles, labeled and tied with a string and sold over counters in stores. We would like very much to do this, but electricity is a 'hand-to-mouth' product. It must be manufactured just as fast as it is consumed. The grocer, the merchant, the druggist and retailers generally lay in a stock of goods which they sell from day to day as demand is made upon them. Not so with electricity. When you turn on an electric light in your house at that instant there is a demand upon the manufacturing capacity of the electric power station, and it may surprise you to learn how quickly that demand is supplied. When you turn the switch or button, indicating that you want electric light, the demand is supplied in less than one-thousandth of a second, and electricity goes flowing back and forth between that lamp of yours and the company's electric power station at the rate of 120 times each second. Sixty times per second it flows from the power station to your lamps and sixty times per second it goes from the lamp back to the power station. The lamp you have turned on has made it necessary, perhaps, to shovel a little more coal under the boilers. But aside from the extra coal which has been consumed in satisfying your demand for electric light, the company has been waiting for that call from you and has provided for it in a way you would never suspect.

"For every electric lamp installed in this city a plant of sufficient size is kept in readiness to supply instantly your demand. The company has installed ready to serve you at your home a meter. From the meter the company has wires leading to a transformer located on a pole within a short distance from your house. From the transformer wires lead back to the power station. There they are connected with engines or water wheels, as the case may be, for power supply. The electric light company must keep ready for you all this equipment from the meter in your house clear back to the engines and water wheels and they must be ready to supply your demand at the instant you turn on your switch.

"From this you will notice that the company is and must be ready for you every moment, 24 hours a day, 365 days in the year. Now if we have, say, 24 customers, and we could command each of the 24 to burn his lamps for one hour per day and never more than one customer during any one hour, then we would have the ideal condition. But if all the 24 customers want to burn their lamps at the same hour each day, then you see we will have to have just 24 times as much wire, generators, engines, boilers and water wheels as we would have if we could supply the 24 one at a time.

"Now all that machinery and copper wire costs money. People with money to invest, whether it be in dry goods stores, drug stores, grocery stores or electric light stores expect returns on their investment—it is strange, but they really do.

"We have already told you that for every lamp you have installed in your homes or store we must have a certain amount of equipment, and on that equipment we should pay a fair living profit. The man does not live who would want as much as even a ten dollar bill invested earning nothing.

"To sum up, the cost of electricity is made up of two items: First, the fixed charges which include interest, depreciation, and all items which remain the same whether you use your lamps

or not. The second item includes coal, oil, power rental and similar costs, which depend on the amount of light you use."

After reading the above it would seem that everyone must know it costs money to produce electricity and we can hardly afford to give it away, and also that it cannot be as cheap as air or water.

The advertising manager of a large concern might urge as an objection to the foregoing that it is too long to be a good advertisement, but when we consider the amount of educational good contained therein, its simplicity, straightforwardness and utmost frankness, I, for one, would have to disagree with him and believe that a great deal of good can be accomplished by its use. It would seem to me that the consumer should be able to gain the best possible understanding of the method of charging for the maximum demand and why, from the use of this matter.

If your solicitor is to get this new or more business a great deal depends on him. If he understands and appreciates the value of handling the public courteously and with consideration, he at once becomes an advertising medium of actual worth to you, and if not can do many dollars worth of harm in comparatively a short time and should be at once dispensed with. This does not apply alone to your solicitor but also to every one connected with your institution and particularly to your collectors, meter readers, service men and office help. Any indifference or negligence on the part of these people is quite likely to cost the company dearly. A lost customer may not be merely for a day or month, but for good, and that loss can then be reckoned at the cash drawer.

Every householder in your city is a prospect if not connected to your mains. It is not a good idea to insist on the prospective customer calling at your office and after considerable formality signing a contract. When we get track of one who has not been in, we send the contract to him in short order. It hardly pays to do business with only those who happen in when the gunning is quite good.

It is good advertising and good business to visit your regular customers as well as the prospective ones. They need and should be given advice upon many points, such as wall decorations, lamp installations, etc., and the lighting company should be only too glad to furnish this advice.

Thirty per cent of the residence customers at the Soo are at present using the electric flatiron, and nearly the entire number were converted to its use the past summer during the advertising campaign. They estimate that we are receiving an increase in each customer's account of not less than forty cents per month for every flatiron they have installed. If this estimate is anywhere near correct, they will receive from two hundred irons about a thousand dollars per annum increase of very desirable business. The irons were placed on a thirty days' trial at cost, and each one proved an excellent advertiser in itself. The plan proved beyond question that the advertising investment (which is what it amounts to) is a good new business getter. Two-thirds of the heating devices, as we all know, make up day load, and, therefore, the accruing profits are, so to speak, velvet. They have not experimented with the free electric sign at the Soo yet, but believe the proposition a good one. Certainly the amount of new business secured from cost installation would warrant the reasonable expenditure. Free lamp renewals to your customers is good advertising, and it is a good idea to refer to the fact occasionally in your advertising matter that you do furnish them free, or it may be forgotten and not appreciated.

DISCUSSION.

Mr. A. C. Marshall, of Port Huron, asked what division of the new business appropriation the members thought should be made; that is, how much to spend on advertising and how much on solicitation.

Mr. T. F. Bechtel, of Grand Rapids, said his company had been spending about one-third on solicitation, one-third on newspaper advertising and one-third on direct-by-mail advertising. They kept only two solicitors in Grand Rapids and purchased the most expensive advertising space; otherwise the proportion might be different. He believed that in purchasing advertising it paid to get the best and they bought a space on the first page of the best daily paper where it stood apart from everything else and where everyone was sure to see it. In soliciting they follow up every building permit issued by the city until they get an absolute answer, yes or no, as to whether the owner will wire the building. If the building is being erected for rent, the case is not rested there, but they keep after the owner until the name of the tenant is learned, and the tenant is solicited for service. They invariably secure the wiring of new residences. Lamps are delivered and renewed free.

Mr. E. F. Phillips, of Detroit, said that the visits of the boy in uniform who renewed the lamps for customers were just as much an advertisement for the company as a circular or glaring headlines in the newspapers. Satisfied customers are the best advertisement a company can have and dissatisfied customers the worst.

Mr. R. W. Hemphill, Jr., of Ann Arbor, said that his company set aside two per cent of its gross receipts this year for promoting new business. For a time they had two solicitors, but owing to their lack of power plant capacity to take care of the business that was coming in, they had to take these off for a time. They were getting up a complete card index of the town, showing the name and location of every possible customer and the kind of service that the customer is taking at present. They had subscribed to the Curtis Advertising Company's service. The results of their efforts were so remarkable that he was surprised that the matter had not been started years ago.

President Chandler, of Sault Ste. Marie, brought out the point that a good deal of the newspaper advertising that had been done by central station companies in the past was money wasted because of its perfunctory character. The company had considered it as a kind of necessary evil to keep the good will of the newspapers and had let the same copy run months at a time instead of looking at the advertising space as a useful means of increasing revenue. He believed newspaper advertising to be one of the best forms of publicity, but it must be done with thought and put where people will see it.

In answer to a question Mr. Phillips, of Detroit, said that free renewals were never furnished at Detroit where a customer had an isolated plant and operated his lamps part of the time from his own plant. This was for the simple reason that the company had no means of knowing whether the lamps were burned out by current generated by the company or by the isolated plant.

Mr. Mauger made the useful suggestion that the small central station companies which could not afford to give time and thought to the wording of advertisements might subscribe to a number of daily papers published in the larger cities where central station companies were doing advertising. By cutting out these advertisements the small company could get the product of the skilled ad. writers of the larger companies at a nominal expense. With a few changes most of these advertisements could be fixed up to suit local conditions in any town.

President Chandler said the policy of his company at Sault Ste. Marie was very liberal toward helping some charitable organizations. They had frequently furnished free lighting for church lawn parties. One of the Catholic priests had been presented with an electric cooking outfit which was used continuously and much appreciated.

Mr. Hemphill said that the State Normal School at Ypsilanti would be presented with an electric cooking outfit by his company, as that school had a manual training department where cooking was taught. The manual training department of the Ann Arbor high school would also be presented with an electric cooking outfit.

Mr. George R. Craven, of Cleveland, said that Mr. F. W. Hawley, of Ludington, had made a rate of three cents per kw-hour on electric cooking and heating work. Central station companies could not expect to do much with this work with rates of 10 cents per kw-hour.

Mr. Bechtel, of Grand Rapids, said his company's experience with electric irons had formerly not been very satisfactory, but the introduction of improved types had changed this. These were now being introduced in Grand Rapids, selling at $3.75.

There were about 275 irons in use. Every new house which they connected was furnished with an electric iron which was left on trial.

President Chandler said that rates at the Soo would, the coming year, be cut down to two cents per kw-hour on cooking and heating. The lighting rate is a maximum of 16 cents per kw-hour on the Wright demand system, with discounts according to the number of hours' use down to 2 cents.

DIRECT BY MAIL ADVERTISING.

Mr. Charles A. Parker, of the Curtis Advertising Company, Detroit, read a paper on "Direct by Mail Advertising of Central Station Current." He said that the past year had seen a wonderful development in the commercial side of the business. This was particularly true of some central stations in the State of Michigan.

A great many of the central stations have, for the first time during the past year, put men into the field to make a personal canvass of their communities and to attempt to close up some portion of the vast volume of business which lies waiting, but the best solicitors are under a severe handicap if they are required to try to work out a territory in which the ground has not been first broken by strong, convincing, enthusiastic, educational advertising.

Mr. Parker saip that he believed in newspaper advertising, but the special object of this paper was to draw attention to the direct-by-mail system. Each manager knows the people he can expect to do business with. Their names are in the directory and the telephone book or are otherwise readily ascertainable.

By publishing a monthly bulletin and sending it through the mails you may present in the course of a year a thousand good strong reasons why these people's homes should be wired and why they should be using electric light, heating devices and power. In order to be strongly effective this advertising must be high grade as regards reading matter, illustrations and form in which it is presented and the typographical arrangement and display. Electricity is too high grade a proposition itself for the manager to descend to the use of cheap, tawdry looking dodgers or to the distribution of carelessly gotten out printed matter.

Second only to the quality of this advertising is its regularity and persistency in issuance. The first announcement creates only a passing interest. The second drives home a new point and so on until the time comes when a man is sufficiently interested that he cannot rest until he talks the matter over with your representative. Which announcement did the business? Not any one of them, but all of them together. There is one crowning reason why central station men of all in the world should be believers in advertising. They are themselves in the advertising business. Every lamp installed for lighting store windows makes you that much more an advertising man. Window illumination and signs are advertising. They should be sold as such. The only strong and convincing argument you can use to the merchant why he should light up his signs and windows after dark is that this light will advertise him, his goods, his location, and his up-to-dateness.

In answer to a question of a member as to whether a direct-by-mail advertising campaign would pay in a town of three or four thousand inhabitants, Mr. Parker said yes, especially in towns where there was day service. As to experience in larger towns, he mentioned that of the South Bend (Ind.) Electric Company where, as a result of the circulation of one piece of advertising, the company had secured nine electric signs and 55 other installations of various kinds.

District Supply Near Omaha.

The Omaha Electric Light & Power Company has gone into the district supply business in a small way by building 5,000-volt transmission lines to three of its surrounding towns, namely Florence, Benson and Dundee. All of the office and trouble work is taken care of from the general offices in Omaha.

Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under.

Among the papers receiving honorable mention at the hands of the committee appointed by the National Electric Light Association in the competition instituted by the Co-operative Electrical Development Association was one by Mr. Charles Nathan Jackson, a brief abstract of which follows:

I have always lived in the small city of C., a town of about thirty thousand inhabitants, in central Ohio, and was interested, to a certain extent, in our local electric light plant. In course of time, however, I purchased the entire property and determined to see if, by increasing the business, I could increase the net earnings. We had a total generating capacity of 600 kw and did not do the municipal lighting. The revenue was about $30,000 per year, and the plant was loaded to its utmost capacity about 5 o'clock in the December afternoons. The manager in charge was a very capable operating man, drawing a salary of $2,000 per year, and when I asked him what we had better do to increase the revenue, he said, "Hire a solicitor and install more machinery." We secured a young man who had sold electricity in another town and started him to work and then began to make plans for increasing the capacity of the plant. We were charging ten cents per kw-hour and the young man had not been at work very long before he secured a contract for a wholesale house that would use about twenty-five arc lamps. He also got contracts for several factories, and I began to think that there was a good prospect of his building up quite a business; however, I did not see any increase in the receipts. Gas was selling at a dollar a thousand cubic feet, and a walk through the business district at night showed that all the saloons, drug stores, restaurants and hotels were using gas. Upon inquiry I found that the cost of electric light to such consumers would be about three times that of gas, and of course they could not afford to pay the difference. The solicitor's business soon began to drop off and in a few months his orders were very few and far between.

In other cities I have seen the electric light company light all the saloons and drug stores and wondered why we could not do it. So I began to search for a man who could get the business. One day, in answer to one of my letters, Mr. Johnson, a man of about thirty-five years, called to see me, and in answer to my question as to what he could do, replied that he did not know, but that if I would give him a guide and a right to ask a few questions, he could soon tell me. I did so and the next day he returned and said that the plant was loaded down with "short burners." He said he could increase the net profits from twenty to thirty thousand dollars per year without additional machinery by cutting rates to some customers and raising rates on undesirable ones. There were a great many saloons, drug stores, restaurants, hotels and other "long burners" that were paying at the present ten-cent rate, $200 per year per kw demanded, which was much too high. Imagine a drug store with forty 16-cp lamps paying $400 per year when the cost of gas would not be over $150 per year; whereas a wholesale store that closes at 5.30 burns the same number of lamps and only pays $50 per year. The fixed expenses are the same for both, but the drug store uses about 4,000 kw-hours and the wholesale store 500 kw-hours. As the cost of coal is not over one-half cent per kw-hour, the drug store would cost for coal $20, the wholesale house $2.50. We were either making a very large profit on one or losing on the other.

I could readily see that this argument was correct and asked him how he would go about it to produce results. He replied that the town was not large enough for him to spend his entire time with us, but that he would charge me $1,800 per year for the services of a solicitor and for his own services he would ask 25 per cent of the increased profits during the first two years, and I accepted.

He first got a friend of our company to agitate a rate ordinance, which was passed. It prohibited a charge in excess of 50 cents per month, per 16-cp lamp to customers using light not over ten hours per day. The "long burners" of course were pleased and the "short burners" never dreamed that it would affect them.

He then sent for the solicitor, who was instructed to charge a flat rate of $5 per month per kw demanded and an extra charge of two cents per kw to one-lamp customers, except in residences where the rate was ten cents per kw-hour—$1 minimum. Lodge rooms, churches and hotels were to receive a special rate.

In October the load curve of the station looked like curve No. 2. The load curve before looked like curve No. 1. He said, "You will notice that the load drops off a little after 6; if we don't do something we will have a curve like No. 3 in December. I am going to start a strong campaign on residence lighting, churches and lodge rooms, which come on at 5 o'clock and get heavier as the other load goes off. He engaged two bright young

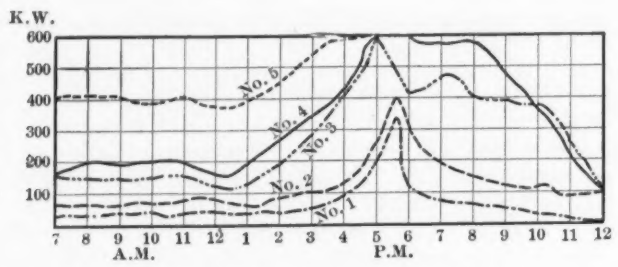


FIG. 1.—LOAD CURVES.

fellows and started them after residence contracts at the old price of ten cents per kw-hour. They would turn the names of all prospective customers over to a stenographer, who would mail them a series of letters and advertising matter on electricity for home use. In that manner they would get from two to four contracts per day. All that time the solicitor was getting all the churches and lodge rooms he could, at a six-cent rate. It was not long before I could see a change in the load curve. It began to fill out after 6 and by Christmas it looked like No. 4. He was not satisfied with that, but said he wanted one to look like No. 5, and that he would get it with motor business.

He began to push motor business at three cents to large and small customers alike. As there was no firm in town that handled motors, we sold them to our customers at cost. He was gradually filling up the "valley" in the load curve and our receipts in March were $5,000, which made me feel pretty good. About that time a big cold storage plant was being built and Johnson went after the business, quoting a two-cent rate. He told me that they would require 100 hp about 600 hours per

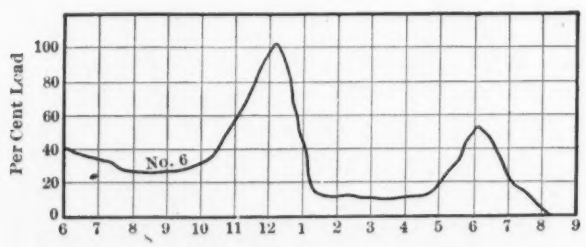


FIG. 2.—ELECTRIC HEAT LOAD CURVE.

year, which at two cents per kw-hour would give us a revenue of $9,000, of which about 75 per cent was clear profit.

When summer came our receipts held up to about $4,000 per month. All the stores were paying their "flat rate." The power customers were paying more than they did in the winter, the refrigerating plant was paying us nearly a thousand dollars per month, and I began to see visions of a good paying property.

Johnson had an office system that was very thorough and yet very simple. He first bought one section (two drawers) of a verticle filing cabinet. The folders were numbered from 1 up. He had another drawer in which he kept his 3x5 index cards. When a new contract came in a work order was issued in quadruplicate (two heavy copies and two tissues); one tissue was put in the customer's folder, and the two heavy copies and the other tissue went to the operating manager, who kept the tissue and passed the two heavy copies to the line foreman and the meter foreman. The operating manager's tissue was kept on his desk so that he could see what orders were in the hands of the men. When the men returned their copies marked "completed," he destroyed his tissue and passed the order back to Johnson, who passed them with the contract to the bookkeeper, who would enter customers' name and rate on the ledger and then would pass them back to Johnson, who filed them in the customer's folder. He issued work orders for meter tests, complaints on service, etc., to the operating department in the same way, always filing his tissues at once, so at any time a glance in the folder would tell what the last move was. All prospective customers had a folder. After a visit, where anything of importance was said or done, he would dictate a "report" and file it. He also had a small desk tray, which he called the "tickler." One set of guides were for the twelve months and one set for thirty-one days. I have seen him dictate a report on a prospective customer, saying that "if Jones & Co. renewed their lease December 1 they would be glad to accept our proposition of April 15th." He would then drop a 3x5 tickler card in the "tickler" for about December 1 calling attention to report of April 15th on Jones & Co. He never tried to remember the slightest thing regarding any deal. He taught his solicitors never to use their memory, but to keep the system in first-class shape.

At the end of the second year the results showed that our revenue was $62,000 per year and about the only increase in operating expenses was for coal. I was very glad to pay him according to our agreement and insisted on retaining him at a salary of $1,200 per year in an advisory capacity only.

We made a special rate of three cents per kw-hour with a minimum of five cents per month per 2-cp lamp, on signs, the customers agreeing not to light them before 5.30. As the sign load would give us a revenue of nearly $60 per year per kw, we considered it the best kind of business.

The gas company, seeing their "long burners" leaving them, and, in return getting our outcasts (short burners) began a very aggressive campaign and offered all sorts of cut-rate propositions. We then advertised complete electric cooking outfits for $80 on time payments and sold electricity for them at two cents per kw-hour. We put out fifty sets in two weeks. The gas manager came to me and asked me how much longer we were going to run that offer. I replied "forever," and he went away declaring that we would go into bankruptcy if we continued at such a price. Johnson contended that we were making a good profit on it at two cents, since the cooking load runs like No. 6. The gas manager intimated that if we would put the price up to three cents he would quit cutting prices in the business district. But we were so strongly intrenched there that we thought we had better let the price remain at two cents. After my experience I can safely say, hire the best commercial man in the country and let him do the rest.

Flat Rates for Small Water Power Plants.

By J. S. Codman.

Flat rates, that is, rates based on the capacity of the customer as determined by his connected load, are the oldest form of rates adopted for the sale of electric service. They are still used in many places, but in the main they have been supplanted by meter rates in spite of great expense for installing, maintaining and reading meters, as well as for additional bookkeeping. Of late years, however, it has come to be recognized, as shown by the introduction of "differential" or "load factor" systems of charging, that a charge on a customer's capacity is a very desirable thing; and in the light of the knowledge obtained from the study of and experience with these systems, it is perhaps an open question if flat rates in an improved form are not after all the best for small stations operated by water power.

The principal objection to flat rates has always been that there was no inducement for a customer to shut off current when it was no longer needed, resulting not only in waste of fuel in a steam plant and in unnecessary wear and tear in either a steam or water plant, but also in an unnecessarily high investment due to high peak load. Another objection is that the long-hour customer benefits at the expense of the short-hour.

It should be remembered, on the other hand, that meter rates, although they do away with the first objection mentioned above, nevertheless greatly increase the discrimination between the long

and short-hour customers, only that the effect is reversed, the short-hour customer now benefiting very greatly at the expense of the long-hour, although the latter is the best customer the station can have. This last fact was not at one time well recognized, but to-day it is recognized very generally and the result has been the adoption by most large companies of some "differential" or "load factor" system, that is, a system whereby the flat rate and the meter rate are combined, and the discrimination between the long-hour and short-hour customers thereby avoided.

As already stated, with flat rates of the old form there is no inducement to the customer to shut off current no longer needed, and this may affect the station in two ways: either by driving up the peak of the load, necessitating greater investment, or by increasing the running expense for fuel, oil, waste, water and repairs due to running. In a steam plant fuel is a large item and its waste is a serious matter, but with a water power plant there is no expense for fuel, and failure, therefore, to shut off current not needed increases running expenses but a trifling amount, and the only serious effect, therefore, that such failure may have is to drive up the station peak. It follows from this that if the tendency to drive up the peak can be done away with, in some way, then flat rates will be superior to meter rates for water power plants on account of their greater simplicity, the saving in meter expense, and the lessened discrimination between the long and short-hour customers.

A decided check on the tendency of flat rates to drive up the station peak can be obtained by simply substituting for the connected load as a basis of charge, the actual load thrown on the station by the customer, that is, his maximum demand. In this way an inducement to the customer to turn off lamps not needed will be created which will in all probability result in a lower station peak, permitting additional customers to be taken without increase of investment.

The practical method of determining the maximum demands of the customers is either to measure them by means of demand indicators or to limit them by means of fuses or circuit-breakers, or by current limiters or controllers of some kind. Either of these methods will also overcome another objection to flat rates not previously mentioned which is the tendency of customers to increase their connected load without the knowledge of the station manager. With a demand indicator or demand limiter in circuit such a change is not likely to be of consequence. Of course the use of demand indicators or current limiters introduces instrument expense and appears, therefore, to do away with one of the particular advantages which flat rates have heretofore had, but this advantage is only partly done away with for the reason that demand indicators and limiters not only cost much less to install than watt-hour meters, but also cost considerably less to maintain and repair. The saving in expense over watt-hour meters should certainly be not less than 50 per cent.

The use of a demand indicator, rather than any device to actually limit demand or otherwise interfere with the service, is probably the best solution of the difficulties of flat rates. In such case the indicator can be read each month and the charge can be based on the monthly reading, or a year's contract can be made for a certain number of lamps or other apparatus, and if in any month this number is exceeded the excess can be charged for. In order to induce the customer to make a year's contract a scale of prices can be adopted making the annual contract rate per lamp equivalent somewhat less per month than the monthly rate. If, for example, the annual contract rate per lamp equivalent per month is 30 cents, with a charge of 50 cents per lamp for each lamp in excess of the number contracted for, it will be for the interest of the customer to contract for as many lamps as he is likely to use regularly each month, and to pay the 50-cent rate only for additional lamps used irregularly. For instance, a customer who uses about ten lamps each month regularly, but occasionally exceeds this number, will contract for 10 lamps at 30 cents per lamp per month, or $3.60 per lamp per year, and for all extra lamps used in a month as shown by demand indicator he will pay the single lamp rate of 50 cents. On the other hand, a customer whose use is very irregular, having a very small demand in some months and a much larger in others, will contract for a few lamps only, paying for the balance the 50-cent monthly rate; or a customer who is likely to be absent during certain months and therefore to have zero demand in those months may find it best to make no contract at all, but simply to pay the 50-cent rate on the monthly reading of the indicator.

Limiting the maximum demand instead of measuring it makes the question of rates somewhat simpler. All that it is necessary to do is to make a contract for a month or a year at a certain rate per lamp equivalent and then to install a device which will prevent the number of lamps agreed upon being exceeded. This plan, however, recognizes the possibility of interference with the customer's service, and for that reason is open to objection. Some customers, however, might prefer a limiter to a demand indicator inasmuch as it would prevent them from inadvertently exceeding the number of lamps for which they could afford to pay, and to such customers a limiter could be furnished with advantage. In any case, if a limiting device is used it should be of such nature that when the customer's demand exceeds the maximum agreed upon, it shall not result in leaving the customer in darkness for more than a second or two at a time, nor in otherwise seriously interfering with his service, and, moreover, service should be completely restored as soon as the demand is reduced to or below the agreed upon maximum. For the above reasons fuses and circuit-breakers are objectionable for use as current controllers. Current limiters, however, which will cause the light to flicker uncomfortably or will turn them on and off at very brief intervals in case more lamps are switched on than are contracted for, but will cease to operate as soon as the extra lamps are switched off, are suitable for the purpose provided they can be made mechanically satisfactory, nor does there appear to be any reason why they should not be made mechanically satisfactory for small customers with direct current or non-inductive alternating loads. For large currents or inductive alternating currents it will probably be found that current limiters are not practical and that demand indicators must be used.

Above are given the advantages of proper flat rates over meter rates for water power plants in general, but the writer is not advocating either system for large water power plants. For these some form of "load factor" system combining the advantages of the "flat" rate and meter rate is to be preferred. These he has discussed elsewhere.*

To summarize briefly, it appears, first, that for small water power plants flat rates are superior to meter rates, (*a*) on account of their greater simplicity; (*b*) on account of the saving in expense of installing and maintaining meters; (*c*) on account of the more equitable distribution of the charges between the long and short-hour customers.

Second, the only serious objection to flat rates for small water power plants, viz.: the tendency to leave lamps burning when not needed, can be largely done away with by the use of the maximum demand as the basis of charge instead of the connected load.

Third, It is usually best to determine the maximum demand by a demand indicator, but for small customers with non-inductive loads who prefer to be protected against the possibility of inadvertently exceeding the number of lights contracted for, current limiters can be used with advantage.

New Business Campaign at Omaha.

The Omaha Electric Light & Power Company has been doing good work recently in getting sign and display lighting as well as in securing effective illumination in stores, as is evidenced by a walk along any of the principal business streets at night. In few cities of the size are so many stores to be found which are so well lighted for the money expended. This is partially due to the extensive use of the new high-efficiency incandescent lamps with proper reflectors. About 95 of these lamps are in use in the business district. The customers pay the first cost of the lamps and reflectors, after which the lamps are renewed free, just as are other lamps on the system.

Four solicitors are employed most of the time. One of these is on the business district and the remainder on outlying districts,

* "Discrimination in Rates," a paper read before the Association of Electric Lighting Engineers of New England, March 21, 1906, and published in the Electrical Age, June, 1906.

from which it can be seen that special effort is being made to get residence business. About 400 electric flatirons have been put in service. They are taken out by solicitors and placed in various homes on approval. The experience in Omaha has been that about 10 per cent of those put out on approval come back. Irons have been mostly placed in the homes of those of moderate means, as this gives better results than attempts to place them among the richest or poorest customers on the lines. Twenty-six irons have been placed during the past summer in Benson, a suburban town of 1,300 inhabitants, four miles distant.

About 2,500-hp in motors were connected last year. A contract for supplying a 1,100-hp grain elevator was closed recently.

FLAMING ARCS FOR BILLBOARD LIGHTING.

A billboard 150 ft. long near the end of the Sixteenth Street viaduct is being lighted by two flaming arcs, the idea being that these big arcs will attract attention by the quantity of light. The contract department of the company is under Mr. J. B. Zimman.

Newspaper Advertising at Grand Rapids.

At the recent Michigan Electric Association convention Mr. T. F. Bechtel, secretary of the Grand Rapids Edison Company, expressed the opinion that the best advertising space was none too good. One of the company's advertisements is reproduced here in full size. It appears at the upper right-hand corner on the first page of the leading daily. The circle is set in the middle of a two-column space, so that there is plenty of white space all around it to make it stand out and command attention.

Making a Good Impression Upon the Public.

At the convention of the Michigan Electric Association at Grand Rapids, October 10 to 12, Mr. R. W. Hemphill, Jr., of the Washtenaw Light & Power Company, Ann Arbor, gave a short talk on "The Importance of Central Station Companies Making a Good Impression Upon the Public." He urged companies to fix up the surroundings of their power stations and offices so that the public could say when passing any of the company's property: "There is a concern that does things right." The power station and storerooms should be kept clean. The public judges by small things. It knows nothing about the efficiency of generators and the like, but it does know whether the property has a generally neat appearance and judges more by this than by the essentials. He told a story of a capitalist in a distant city who purchased an electric light company and who, upon arriving in town, after inquiry for the electric light company's office, found himself in a printing office. Thinking that there was some mistake he went out and made further inquiries, but was again directed to the printing office. In the back of this printing establishment, he found the superintendent of the company who was just closing his desk to go home, the reason being that it was too dark to see to work there any longer. The new owner startled the natives by changing the office to the best location in town. While the wisdom of this change was questioned by many, it proved abundantly by the results that it was worth while. To conclude, the general policy of a company should be that of a servant of the people rather than an autocrat.

A Traveling Window.

A dealer in aluminum ware in Cleveland, Ohio, has installed in one of his show windows an arrangement shown in the accompanying illustrations whereby the show capacity of the window is increased four-fold. The window floor is arranged so that it revolves like an endless chain over a drum at either side of the window, and different aluminum articles, some 200 in number, are wired to the moving window floor. Aside from enabling 200 articles to be shown where there was otherwise only space for 50, the exhibit has attracted much attention from passers-by. By the use of a rubber belt covered with felt, the upper surface moving horizontally in the floor plane of the window, the effect of such an arrangement could be very much improved.

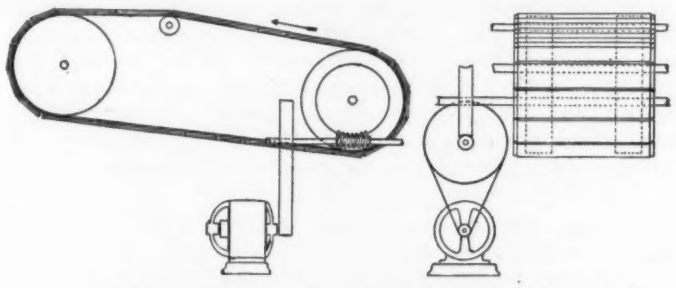


FIG. 1.—DETAILS OF TRAVELING WINDOW FLOOR.

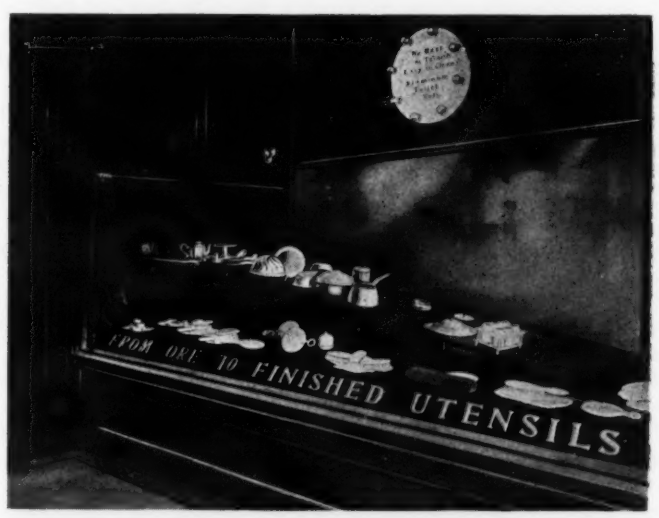


FIG. 2.—WINDOW WITH TRAVELING FLOOR.

Lamps and Renewals.

At the Michigan Electric Association convention at Grand Rapids, October 10 to 12, considerable interest was manifested in the question of lamp renewals following a paper on "The New Incandescent Lamps," by Mr. F. W. Willcox. A question by one of the members as to the number of companies in towns of five to six thousand inhabitants which gave free lamp renewals, indicated by the absence of response that there were no such companies represented.

A question was asked as to the relative advantages of the

round tipless bulb and the standard pear-shaped bulb. Mr. Willcox replied that the only advantage of the burner was that of appearance. Many preferred the round tipless bulb and there was a steady demand for this type of lamp. A story was told of a customer of a central station company which did not give free lamp renewals. He burned out his lamps one by one and rather than purchase new lamps, moved lamps from one socket to another until finally he had only one good lamp left in the house and this he carried from room to room as he wanted light. President Chandler said that their experience at the Soo before free lamp renewals were given brought out some cases almost as bad as that.

Mr. Marshall, of Port Huron, said that his company did not give free renewals. There were three dealers selling lamps in the town. Two of these dealers were formerly selling a good lamp, while the third sold a very poor lamp. The company thought of beginning the practice of free lamp renewals, but instead of doing this, let the dealers keep the business on condition that they would all sell only a good grade of lamp. While the company did not give free renewals on standard lamps, 250-watt incandescent lamps were furnished and maintained free for the reason that these units were used in the same way as arc lamps, which latter the company furnished and maintained free. Mr. Willcox called attention to the ragged appearance of the lamps in small cities where free renewals were not given, some lamps being out and others burning very dimly. Companies should strive to make their service look well as well as serve well. The solution of this whole question was in free renewals. He said that the manufacturers would like an expression of opinion as to what sizes of high efficiency filament lamps should be put on the market in ratings under 50 watts. The consensus of opinion seemed to be that the 30, 20 and 10-watt sizes would answer practically all requirements. The importance of keeping down the number of kinds or sizes of lamps in the future was emphasized by Mr. Willcox with the statement that the General Electric lamp works have to maintain a stock of about 78,000,000 lamps in order to be able to fill orders on the immense variety of shapes, sizes and voltages of lamps now on the market.

Mr. Bechtel, of Grand Rapids, gave the practice in that city. The first installation of lamps is free, as well as the lamp renewals thereafter. Free renewals are delivered to customers by wagon. The city is divided into six districts, one for each working day of the week and the renewal wagon visits each district once a week, taking one district a day. Customers are kept informed as to the days the renewal wagon visits that district. The small cost of maintaining this free renewal service is not to be considered when the good will toward the company which it promotes is thought of. The business streets are patrolled twice a week and lamps which are out and dim are replaced.

Electricity Versus Kerosene in Residence Lighting.

It is too often taken for granted both by the public and by electric lighting men that electric light cannot compete in economy with kerosene lamps in a residence. That electric light is much cleaner and more convenient than kerosene lamps is, of course, admitted by all. It is also admitted that a kerosene lamp has too many of the characteristics of a stove to make it pleasant company on a warm summer evening. When it comes to a matter of dollars and cents, there is a general belief that kerosene is considerably cheaper. This is too often allowed to go uncontradicted, or perhaps some electric light men have quietly accepted it without taking the trouble to go into a close investigation of the matter. The following data taken from the actual experience of a certain family with both kinds of light are of considerable interest in this connection:

The house in question is in the suburbs of one of our large cities. The owner of the house, who had never paid much attention to what his kerosene bills were, suddenly awoke one day to the fact that during the winter months he was paying $1.50 a month for kerosene at 10 cents per gallon. He could only surmise what he had been paying for broken lamp chimneys and he had uncomfortable premonitions as to what his kalsomining bills would come to next spring, as the kerosene lamps frequently got to smoking when no one was in the room, depositing soot over the walls, ceilings, and contents of the room, until every place where a lamp ordinarily stood could be told at a glance by any stranger because of the black spot above it. The house contained nine ordinary rooms besides a store room, two bath rooms and a basement. There were three adults and two small children in the family. It was usually necessary to keep at least five kerosene lamps burning most of the evening in order to have light where it was needed. One lamp was needed in the living room, one in the dining room, one in the kitchen, one in the bath room and one in an upstairs bed room. Sometimes more than five would be used, but seldom less and even with that number there was considerable carrying of lamps from one room to another.

Electric lamps was installed in this residence. The Wright demand system of charging was used by the central station company rendering the service. The rate was 20 cents per kw-hour for all current used up to an equivalent of 30 hours' use per month of the maximum demand for the month, as indicated by the demand meter. For all over that amount the rate was 10 cents per kw-hour. The minimum bill was $1.00.

The first year electric light was used in this house the average monthly bill was $1.28. The highest bill was $2.17. It goes without saying that the members of the family were careful about turning off lamps when not in use, but every one had plenty of light wherever and whenever it was needed. The illumination in the house was well planned so as to get the maximum useful light where it was wanted, so there was very little waste in this respect. The lighting was far superior to what it had been previously with kerosene lamps.

While no figures are available on the cost of kerosene for this house for an entire year, there is no doubt whatever that when the cost of kalsomining or papering and lamp chimneys is taken into account the cost of kerosene lamps would be above that of electric light. In order to keep the rooms in the same condition with kerosene lamps as with electric light it would be necessary to spend each year in redecorating as much as the entire cost of kerosene for the year and probably more.

LETTERS TO THE EDITORS.

Testing of Lightning Arresters.

To the Editors of Electrical World:

SIRS:—The article in your first issue of August by J. H. Kohler on the "Testing of Lightning Arresters," is one of considerable interest and might well be elaborated with profit to the entire electrical fraternity. As we read Mr. Kohler's article, it is proposed that the relative merits of various types or groups of lightning arresters be compared by means of a "Figure of Merit." The author, after admitting the lack of investigation proposes the following tentative equation: That the "Figure of Merit" is directly proportional to some function of the dynamic breakdown voltage, and inversely proportional to some function of the oscillatory voltage. Now, it would certainly be a benefit to all interested parties to have defined by an equation the merits of an arrester; but unfortunately, the factors which should go to make up the equation are either not known, or if known, so that their nature can be specified, their relative importance, or weights, if the expression can be used, is doubtful. Even in simpler cases, where all possible data are known or can be learned by test easily, such an equation as Mr. Kohler proposes is most difficult to frame. Take, for example, the case of two instruments which are to be compared. The relative value of an instrument depends on a number of factors, two of which, the torque and the watt loss in the armature, are usually linked together. Considering these alone, the "Figure of Merit" or the "comparator," to coin a word, would equal torque divided by the watt loss. But these two factors, although possibly the most important, are not the only ones to be considered, others which might be mentioned being the weight of the moving element, the total watt loss, the aperiodic qualities, the scale length, the tem-

perature coefficient, and finally, even the cost. Now, all these factors in the case of an instrument are definitely and absolutely known, yet it is somewhat difficult to specify with what weights they are to be put into the equation.

Returning again to the comparator for lightning arresters, just as the expression $T/\sqrt{W}$ does not give a fair relative value for an instrument, so the ratio of the dynamic breakdown voltage to the oscillatory breakdown voltage is very far from giving a line on the value of the arresters. Consider, for example, the breakdown on dynamic voltage. At frequencies near normal, the breakdown point need be only enough higher than the operating voltage to allow a reasonable factor of safety to take care of small rises of voltage; but a rise in voltage due to changes of load, surges due to switching, etc., which are now thought to be of moderately low frequencies, should be taken care of readily. Thus, an arrester with a dynamic breakdown ten times higher than that of some other arrester, far from being ten times as good, would really be of considerably less value.

As far as breakdown on oscillatory voltage is concerned, it is probably true that, all other things being equal, the arrester with the smaller equivalent spark gap will be the better; but it cannot at all be argued that since the spark gap equivalent in one arrester is one-half that of another, that the first is twice as good as the second. This is merely because the actual breakdown point of an arrester on oscillatory voltage need only be lower by a reasonable factory of safety than the puncturing voltage of the apparatus to be protected, to make the arrester perfectly satisfactory as regards this feature.

An equation giving a "Figure of Merit," to be complete must, of course, contain a factor for each of the qualities which would go to make up a perfect arrester. Of these, in a good arrester, first and foremost is the ability to carry off the lightning discharge rapidly and completely; secondly, to extinguish or quench without fail the dynamic arc which inevitably tends to follow the oscillatory discharge.

As regards the first quality mentioned, no "figure of merit" which does not include the ability of carrying off the entire discharge is of any value. For how often in answer to the question "Did the arrester operate at the time the damage occurred?" do we get the answer "Yes, the arrester operated violently." This is the crucial point of an arrester, for obviously an arrester may have high breakdown on dynamic voltage and low breakdown on oscillatory voltage, and consequently a high "Figure of Merit"; and yet if only part of the discharge is taken to ground through the arrester, the protective value is zero.

Secondly, the ability of the arrester to extinguish the arc positively and without damage to itself is of paramount importance, not only on account of the expensive renewals, but because if an arc holds, it often means a shut-down; and to many companies, a shut-down is more serious than the loss of some apparatus. The difficulty, however, of expressing the value of these two considerations, viz.: The conductivity of the discharge path, and the quenching power, in terms of numbers, is not slight.

In few words, therefore, a "Figure of Merit" for an arrester should combine a considerable number of factors. It should vary directly as the ability to extinguish the dynamic arc; inversely as the impedance it offers to the passage of the oscillatory discharge (equivalent spark gap); inversely as its time factor (rapidity of discharge); directly as the ease of installing, testing and maintaining; and finally, inversely as the cost.

Pittsfield, Mass. Francis H. Bowman.

Legislative Influence on Meter Inspection.

To the Editors of Electrical World:

Sirs:—In an article entitled "Legislative Influence on Meter Inspection" in your first issue of October, you state that the Canadian type of legislation prevents the central station from checking a meter *in situ*. You certainly have been misinformed as to this feature of the Canadian law. The central-station inspector can inspect his meters *in situ* every day in the year if he so desires provided he does not break the seal. If the seal is broken a reinspection by the department becomes necessary; but the fee for these interim tests is only fifty cents regardless of the capacity of the meter. The law does, however, prohibit the testing of meters *in situ* or otherwise by irresponsible and self-constituted inspectors who, until the law was amended, were in the habit of making raids from the United States and causing both central station and consumer very great expense and annoyance by their interference. In electricity, as in gas and the sale of all other commodities, the Canadian Government is simply applying the Weights and Measures Act, and I take it the sellers of electricity, no more than other honest vendors, object to the use of just measures.

Ottawa, Canada. Ormond Higman,
Chief Electrical Engineer,
Electrical Standards Laboratory.

[We regret very much that, through insufficient information, a wrong construction was given to the governmental regulation to which the above letter refers, and we thank Mr. Higman for making the necessary correction.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Alternating-Current Generators.—Lincoln.—The first part of an illustrated serial on the construction, performance and operation of alternating-current generators. After some notes on general types, he deals with the construction of the frame, bed plate, stationary armature, terminals and rotating field, and describes a new form of field core for small high-speed generators. He then discusses the construction of field coils and the use of a composite winding.—*Elec. Jour.*, October.

Transformer Oil.—Kintner.—An article on the treatment of transformer oil, and especially on methods of removing moisture from the oil, which is a matter of great practical importance. There are six ways of effecting the separation of oil and water: (1) Mechanical separation, (2) capillarity, (3) electrostatic force, (4) heating, (5) vacuum and heating, and (6) dehydrating. The last-named method is considered to be the best one by the author, who describes an outfit devised by the engineers of the Westinghouse Company and employing this principle. This outfit circulates the oil to be dried through a treating tank in which is placed a dehydrating material. The oil after passing through this dehydrating chamber is fitered and thus all foreign materials that are in the oil, as well as any of the dehydrating material that may have followed through are removed. It has been found possible with an outfit of this kind to dry a thousand gallons of oil in a day, and to have this oil as dry as required for the highest voltage service. Lime is the material employed in the dehydrating tank. Dry sand has generally been used for the filtering material, although in some instances it has been found advantageous to mix in certain proportions of bone-black and fuller's earth, these last two having the property of tending to clear the color of the oil. As a rule dry sand will be found sufficient.—*Elec. Jour.*, October.

Lamps and Lighting.

Tungsten Lamp and Osram Lamp.—Uppenborn and Lux.—Some supplementary comparative tests of carbon filament lamps, tantalum lamps, osmium lamps and tungsten lamps are described by Uppenborn, and the results are given in diagrams. These four types of 110-volt lamps were tested within wide limits of e.m.f., between 70 and 170 volts, and the current, candle-power and the watts per candle-power were determined for each voltage in percentages of the normal value at 110 volts. The curves show clearly how little the tungsten lamp is influenced by variation of voltage. Uppenborn then makes a comparison between the cost of gas incandescent lighting and electric lighting with tungsten lamps under the local conditions prevailing in Munich,

where 1,000 cu. ft. of gas cost $1.63 and the electric kw-hour for lighting costs 15 cents. Under these conditions the relative cost of gas incandescent lighting is 0.675 cent, and of electric lighting with tungsten lamps 0.9625 cent per 60-cp lamp-hour. Lux

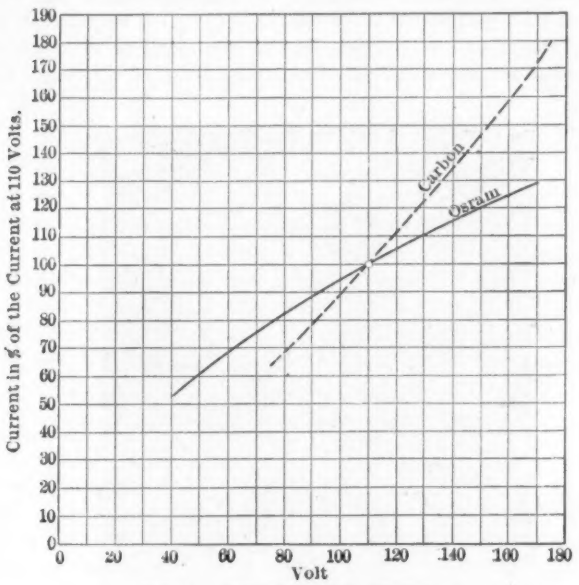


FIG. 1.—CONSUMPTION CURVES.

gives the results of some comparative tests on carbon filament and osram lamps made in his laboratory. The tests were made

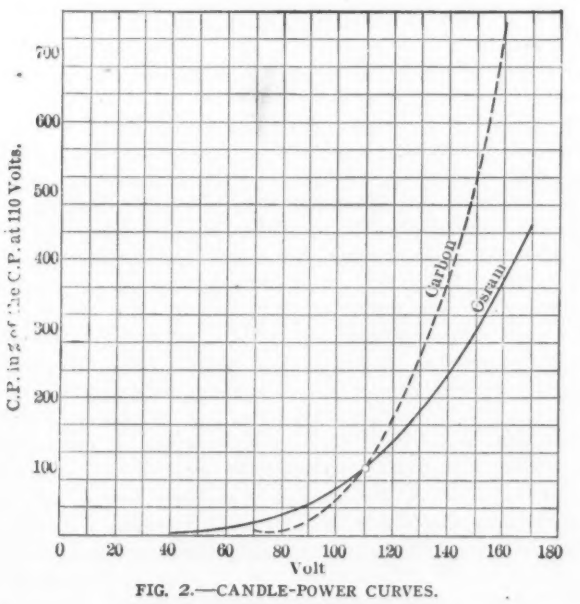


FIG. 2.—CANDLE-POWER CURVES.

in the same way as those of Uppenborn described above. The normal voltage was 110, and the current consumed at other volt-

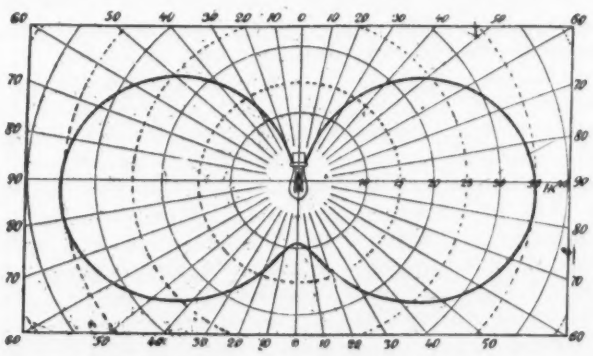


FIG. 4.—DISTRIBUTION OF LIGHT FROM OSRAM LAMP.

ages was determined in percentages of the normal current at 110 volts. The results are plotted in Fig. 1, the drawn-out curve relating to the osram lamp and the dotted curve to the carbon filament lamp. In the same way Fig. 2 gives the hefner candle-power at different voltages in percentages of the normal candle-power at 110 volts, and Fig. 3 the watts per hefner candle-power in percentage of the normal watts per hefner candle-power at

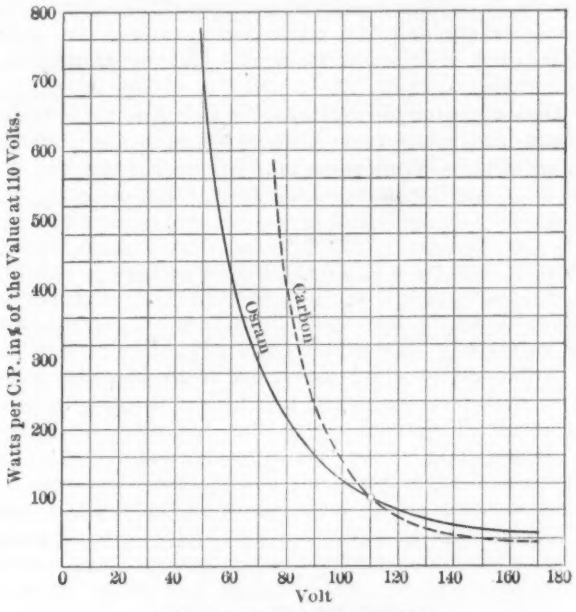


FIG. 3.—WATTS PER HEFNER.

110 volts. A comparison of these curves with those of Uppenborn shows a very strong similarity between the behavior of the tungsten lamp and the osram lamp (the filament of the latter has been stated to be in effect an alloy of tungsten and osmium, the chief constituent being tungsten). It is said that the osram lamp will be made for voltages up to 220. Fig. 4 gives the photometric curve of the distribution of light from an osram lamp. The mean horizontal candle-power is 32 hefner cp, the mean spherical candle-power is 25.2, and mean hemispherical candle-power is 27.68 for the lower hemisphere and 22.90 for the upper hemisphere. Bolometric tests have shown that the horizontal total radiation of osram lamps is 0.00016 watt per square centimeter of bolometric surface at a distance of 1 meter from the source of radiation. The corresponding horizontal radiation of a 25-cp, 95-watt carbon filament lamp is 0.000745 watt.—*Zeit. f. Beleucht,* September 10.

Tungsten Lamps.—A summary of various recent publications on different types of tungsten lamps.—*La Rev. Elec.,* September 30.

Power.

Reciprocating Steam Engines Versus Steam Turbines.—HAWCOCK.—A comparison of actual operation during a year between two power houses of thoroughly modern type and construction, one being operated by reciprocating engines and the other by steam turbines. The comparison of the different costs both in boiler house and in generating house is carried out in detail, the final results for the boiler house being given in the following table:

Boiler Room	Percentage Total Cost Kw-hour, Engine Sta.	Percentage of Total Boiler Room Cost.	Percentage of Total Cost Kw-hour Turbine Station to Engine Station.	Percentage of Total Cost Turbine to Engine.	Ratio Turbine to Engine	Turbine to + = Increase Engine to − = Decrease.
Total labor	8.5	80.2	4.9	46.2	0.576	−42.3%
Total repair	2.1	19.8	2.3	21.7	1.095	+ 9.5%
Total cost....	10.6	100.0	7.2	67.9		

In the article the cost of all the different items making up the total cost is analyzed in great detail and the results are given in a series of tables for both plants. In the generating plant the steam turbine also shows to advantage.—*Cassier's Mag.,* October.

Valves for High-Speed Pumps.—STURM.—The centrifugal pump is best suited for electirc driving, and will be used whenever saving of space and low first cost are of importance; for instance, in mines, etc. On the other hand, where highest economy of operation is of principal importance, as in municipal water works, etc., piston pumps will probably maintain their position, but it will be necessary to adapt them more generally to electric operation. All attempts to connect these pumps directly with

electric motors have now been abandoned. While the designers endeavor to construct piston pumps for as high speeds as possible, they no longer attempt to make these speeds so high that direct driving by motors would be possible. The author considers the Gutermuth valve for piston pumps to be a very great improvement, and describes it in detail.—*Elek. u. Masch.*, October 7.

Power Station Economy.—Bibbins.—An article on the influence of load factor and prime-mover characteristics on power station economy, based on a recent paper read before the American Institute of Electrical Engineers.—*Elec. Jour.*, October.

Traction.

Corrosion of Iron Pipes by Stray Currents.—Haber and Goldschmidt.—A translation in abstract of their German paper on some tests made by the authors in Strassburg, on the effects of the stray currents of tramways on gas and water pipes. The strength of the current which passes out of an iron pipe is not sufficient to determine the extent to which it is being attacked by the current. The condition of the iron must be known, namely, whether it is in the "active" state, and therefore destructible, or in the "passive" state and therefore indestructible. Faraday's law holds always good, according to which 1 amp. passing from the pipe to earth destroys $1.024 - 1.024x$ grams of iron by oxidation, and at the same time develops $0.298x$ grams of oxygen. Here x may be anything between zero and unity, depending on whether the iron is active or passive. If the iron is completely active, then $x = 0$, and the whole work of the current is to oxidize and destroy the iron, no oxygen gas being set free. On the other hand, if the iron is in the passive state, then $x =$ unity, and the whole work of the current is the evolution of oxygen gas, no iron being oxidized or destroyed. Whether the iron is in the active or passive state, depends on the electrolyte; that is, in tramway practice, on the nature of the soil. The electrolytic current acts on iron as rust does. Circumstances which promote or prevent rusting will favor or hinder electrochemical action. The worst effects are produced by chlorides (like common salt) which almost entirely prevent any alkalide reaction. Sulphates slightly promote rust, but are much better than chlorides. Nitrates prevent rust. With bicarbonates much depends on whether the carbon dioxide is present in the free state, or whether it is gradually generated. Besides chlorids, free carbon dioxide in the moisture of the earth is a great source of danger to iron. In this way it is possible to map the ground out into dangerous and harmless zones. In the tests made in Strassburg currents were found to pass from the pipes to the rails, the iron being in the active state. The current passed for the most part out at the upper side of the pipes, this side being nearer to the rails. The greater part of the current passing through the earth was carried by the pipes, and yet no signs could be discovered of any corrosion. Judging from the chemical composition of the soil corrosion was possible quite apart from the earth currents, since the air contained in the earth was found to have from 1 to 8 per cent carbonic acid.—Lond. *Elec.*, September 28.

Municipal Tramway Association.—In a continuation of the report of the fifth annual convention of the British Municipal Tramways Association, the following papers are given: Smithson discussed some important points of the policy of the tramways committee in a municipally-operated system; Bullough, in a paper on tramway track work, gave notes on concrete, rails, points and crossings, tie bars, fish plates, joints, etc. Hulford discussed the depreciation and renewal funds in relation to tramway undertakings, and gave statistical data on British roads.—Lond. *Elec.*, September 28.

Rails.—Colby.—A paper read before the American Institute of Mining Engineers and the Iron and Steel Institute, giving a comparison of American and foreign rail specifications, with a proposed standard specification of American rails rolled for export.—*Bi-Monthly Bull. Amer. Inst. Min. Eng.*, September.

Installations, Systems and Appliances.

Electro-Magnetic Control of Governors.—Speyer.—Central stations supplying energy for light, power and traction must employ some means for steadying the bus-bar pressure to prevent serious fluctuations of voltage due to the traction load. If no battery is to be used, the following method may be employed and is said to have given satisfactory results in various European central stations, especially in Wiesbaden, where no battery is provided in the station. An electro-magnetic coil is attached to one end of the engine governor, as shown in Fig. 5. The current in flowing back from the traction load to the negative terminal of the dynamo is passed around the electro-magnet, *H*, with the

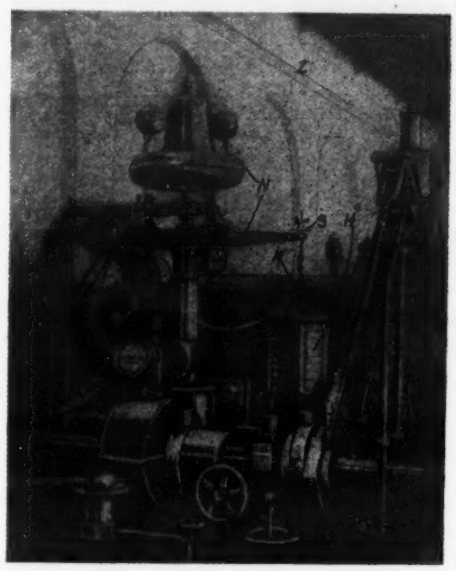


FIG. 5.—CONTROL OF GOVERNORS.

result that the core, *M*, is pulled down to a greater or less extent. The amount the core, *M*, will be pulled down is directly proportional to the load. As seen from the illustration, this core is attached to the governor, *N*, in such a way as to help it in its working, with the result that the opening and closing of the steam admission valves, corresponding to the varying load, is regulated in a far shorter time than is possible when the mechanical governor is used alone. It is not necessary to pass the whole current of the return cable through the electro-magnet; for instance, in Wiesbaden only 1/7 of the total current is used. With the same electro-magnet it is possible by varying this proportion of the current, to regulate to some extent the revolutions of the engine; they may for instance be made the same at full as at no load, or they may be caused to be even greater at full load than at no load. Though this method of keeping the bus-bar pressure constant possesses the distinct advantage of doing away with a battery, it does not allow one to run the engine and work the boilers at their most economical and constant load, with a result that there may perhaps be a greater coal consumption than if a battery is used. With the latter it is possible to have constant steady load on the engine and to arrange for the extra load to be taken up by the battery. Therefore, in comparing the two methods, one of the points to be considered is whether the possible extra coal expenses of the station will come out higher than those rightly chargeable to the maintenance of the battery.—Lond. *Elec. Rev.*, October 5.

Rotary Converter Trouble.—Sommer.—An article on "Experience on the Road," referring to a case in which a 200-kw, 60-cycle, 600-volt rotary converter was reported operating unsatisfactorily. Investigation showed that the transformer connections were all right, and the insulation of the machine not defective. The sub-station operators reported that at times the rotary operated very satisfactorily, and at other times very unsatisfactorily. The author decided to observe operations closely for a few days. Readings of loads were taken for three or four days, and the behavior of the machine and time of readings noted. The power for this converter came from a large lighting and power station. Access was had to the switchboard record sheets. On comparing the author's observations and the switchboard attendant's sheets, it was noted that the operation of the converter was always bad when two particular generators in the power house were supplying power to the bus-bars to which the converter was connected. When the other generators were supplying the power, the operation of the converter was good, and

particularly with one 3,000-kw fly-wheel type generator supplying power, the behavior of the converter was very good indeed, loads up to 100 per cent momentary overload being satisfactorily carried. It was found that the machines that supplied power during the periods of unsatisfactory operation of the converter did not have copper dampers. As the rotary itself was obviously not defective, an agreement was entered into between the railway company and the power company, by which the latter was to furnish power only from the generators which gave satisfactory service.—*Elec. Jour.*, October.

Wires, Wiring and Conduits.

Wire Drawing.—An illustrated description of a new continuous wire-drawing machine, invented by Carter and Hodgson. The special features claimed for the machine are that slipping on the drums is prevented. The compensating mechanism which automatically compensates the load on the wire for varying elongation and causes the wire to be always evenly stressed, consists essentially in building up the driving shaft in sections, and inserting between each section a differential gear which is designed on the sun-and-planet principle. The wire is wound round three drawing-through drums and each drum is driven at a speed corresponding to the reduction and elongation of the wire as it is drawn through the holes of the different reducing plates. Should, however, the tension in the wire be increased between the draw-plate and the drum, then the compensating gear comes into action, and retards the speed of the drum. By this means it is claimed that an even tension in the wire is maintained and slipping prevented. The main driving shaft is made up in sections, as shown in Fig. 6. The first length, *a*, is rotated

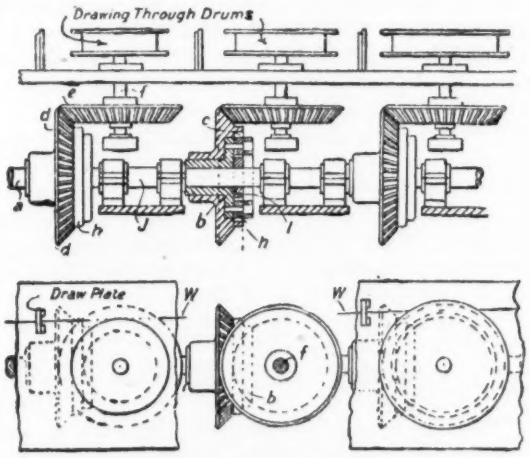


FIG. 6.—WIRE DRAWING.

in any convenient manner. On each section there is keyed a flanged cage, *b*, which contains four spur wheels, *c* (Fig. 7),

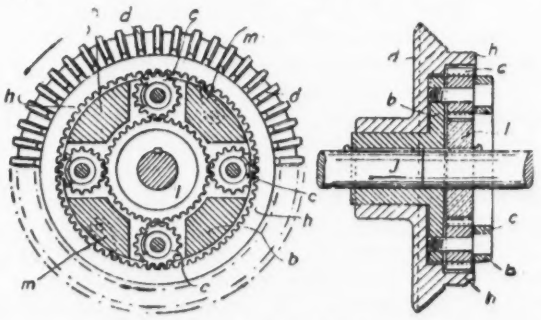


FIG. 7.—WIRE DRAWING.

freely mounted on studs secured to the cage. A large bevel wheel, *d*, rotates on the boss of the flanged cage. This wheel gears with another bevel wheel, *e*, which is keyed on the shaft, *f*, of the corresponding drawing-through drum. The bevel wheel, *d*, is in one with an internal spur wheel, *h*, with which the pinions, *c*, are in gear. One end of the main driving shaft, *j*, is extended into a recess in the boss of the flanged cage for support, and upon *j* and each succeeding section the spur wheel, *l*, is fitted. This spur wheel is of such diameter as to gear with the pinions, *c*. At the back of the flanged cage recesses are sunk for the reception of pawls, *m*, and springs. These springs press the pawls into gear with the teeth of the internal wheel, *h*. The rotating motion of the shaft, *a*, is transmitted to the drawing-through drum through the bevel gears, *d* and *e* (see Fig. 7). It is also transmitted to the bevel wheel, *d*, through a sun-and-planet gear. The pawls which gear with the teeth of the internal wheel are so arranged as to admit of the drawing-through drums revolving in the direction shown by the arrow for drawing and stretching the wire, *W*, and for preventing the bevel wheel, *l*, becoming stationary, and the subsequent sections of the machine stopping whenever there is no tension on any one of the drawing-through drums. It will be seen that if the speed of the drawing-through drum is sufficient to keep the wire taut, the pinions, *c*, will not rotate about their axes, and the drive will then be as though the sections were positively connected. If the tension in the wire between any two of the winding drums be increased, the drum will be retarded, and will not then draw a sufficient length of wire through the reducing plate for supplying the next drawing-through drum. By means of the compensating gear, the speed of the drum will be increased above the normal rate, thus increasing the tension in the wire between that drum and the previous one, thereby assisting to rotate the previous drum and draw the wire through the reducing plate. Similarly, the speed of the succeeding drums is increased, and the wire is taken off from the preceding drum. By this means it is claimed a more equalized tension is maintained, and slipping round the drum prevented. Further, the winding drums are so tapered that the wire tightens on them instead of the opposite, which is usually the case.—*The Engineer* (London), October 5.

Electro-Physics and Magnetism.

Leakage Currents in Moisture on Glass Surfaces.—TROUTON AND SEARLE.—An attempt to explain the very peculiar behavior of the leakage currents over the surface of non-conductors on which moisture has condensed on account of exposure to ordinary atmospheric conditions. In many cases it is found that the resistance is enormously greater if the current passes in one direction than in the opposite direction. The general character of the phenomena is as follows: On a difference of potential being continuously applied across a surface, say, of glass between two metallic electrodes, the current is observed to gradually diminish with time. In addition, if the current is reversed at any moment during the interval, it is found to be different from the direct current—sometimes being as much as six or seven times as much as the direct current. The exact ratio of the currents for any given hygrometric state depends upon the length of time the current has been allowed to run before reversal. The authors' experiments led them to the following conclusions: The falling off observed in the leakage currents is due to the formation of a film of oxide on the electrode, or in the case of platinum of gas. The alteration in the amount of the current on reversal is due to this oxide, or gas, as the case may be, being reduced through the action of the reversal current itself. The initial resistance of a "grid" varies very rapidly for variations in the hygrometric state of the surrounding atmosphere for values above 80 per cent of moisture, and suggests its applicability to measuring the hygrometric state. The currents sent by different electromotive forces do not follow Ohm's law, but are in a greater proportion than given by it for high electromotive forces.—*Phil. Mag.*, October.

Loss in Dielectrics.—HUMANN.—An account of an experimental investigation of the loss in dielectrics at high alternating-current voltages. The author has tested a great number of cables and finds that the loss can be represented by the following formula: $W = a e^3 n c$, where W is the loss in watts, a is a constant, e is the effective voltage, n is the frequency of the alternating current, and c is the capacity of the condenser in farads. Some data are also given on the way the loss in the dielectric depends upon the temperature. Since the loss is proportional to the frequency, the loss per cycle is independent of the frequency, and the author concludes that the effect is one of dielectric hysteresis.—*Elek. Bahnen*, August 24; September 4, 14 and 24.

Afterglow.—TROWBRIDGE.—An experimental investigation of the duration of the phosphorescence which is produced in a gas by an electrodeless ring discharge and which is generally known as the afterglow. The author endeavored to determine some of the

conditions under which the afterglow is formed; he studied especially the effect of variation of pressure. The subject is of special interest since the afterglow has a suggestive resemblance to certain unexplained glows which occur in the upper regions of the earth's atmosphere, namely, the persistent luminous streaks or trains which are produced by very large meteors.—*Phys. Rev.*, October.

Electro-Physics and Batteries.

Electrolytic Precipitation of Bronzes.—Curry.—An account of an experimental investigation which shows that the best plating solution for bronzes should contain about 5 grams of free oxalic acid and 55 grams of ammonium oxalate per 1,000 c.c. of water. The relative amounts of copper and tin in solution may be shifted in any ratio, depending on the composition of the plates desired. The cathode should be rotated if possible. It has been found to be very difficult to precipitate a good bronze with less than 75 per cent copper content. A low current density at the cathode is necessary. The anode dissolves better when rotated.—*Jour. of Phys. Chem.*, October.

Discovery and Invention.—Acheson.—His lecture before the students of Cornell University on "Discovery and Invention," giving many interesting historical notes on his own work with carborundum, artificial carbide and siloxicon.—*Elec. Jour.*, October.

Units, Measurements and Instruments

Electric Instrument for Measuring the Speed of Wind.—Goldschmidt.—A description of an electrical anemometer. It depends for its action upon the variations in temperature, and therefore of the resistance, of a platinum wire heated by an electric current and exposed to the cooling action of the wind. In order to compensate for the effect of variations in the temperature of the air itself, another similar platinum wire, shielded from the wind, is contained in the apparatus, and the resistances of the two are compared. The measuring apparatus consists of a Wheatstone bridge arrangement, of which the two platinum wires form two of the arms, and is so adjusted that when they are of equal resistance, the galvanometer is not deflected. After a balance has been attained no further alternation of the ratio arms is made, and the deflection of the galvanometer is used to indicate directly the velocity of the wind. A very simple method is used to calibrate the instrument. The apparatus is mounted at the edge of a large revolving stand and calm air is driven through at a series of known speeds, while the deflection of the galvanometer was noted. A great advantage of this system over the usual mechanical anemometer is its freedom from inertia errors and the rapidity with which it responds to small changes in velocity of the wind. The leads connecting the measuring apparatus with the anemometer wire can, of course, be made of considerable length without affecting the accuracy of the indications. The apparatus is particularly suited for use with a recording galvanometer, and an electrical recording weather cock, which acts by altering the position of a contact on a circular slide wire, has been devised, so that the direction as well as the velocity of the wind can be recorded at the same time.—Lond. *Elec.*, October 5.

Switchboard Instruments.—Rypinski.—An illustrated description of the Kelvin sector ammeter and voltmeter, which are specially suitable for simple switchboards in small stations. Kelvin never employs the jewel and pivot mounting, but uses arrangements such as the knife-edge bearing, the filament suspension or the ligament suspension. The action of his sector meter depends upon the pull exerted on an iron core suspended within a solenoid acting in opposition to the pull of gravity on counterbalancing weights. The novelty of the device lies in the use of a long solenoid giving an intense and uniform field in combination with a saturated core and an ingenious control mechanism. The core is made of a special grade of iron remarkably low in magnetic retentivity. The constructions of the voltmeter and ammeter are described and illustrated.—*Elek. Jour.*, October.

Meter.—A communication from the Reichsanstalt describing in detail the construction and testing of a single-phase induction meter of the Siemens-Schuckert Works, for frequencies between 80 and 120, and for currents up to 300 amp., and voltages up to 500 volts. This meter has been admitted for calibration by the Reichsanstalt and, according to law, its construction is described in detail with the aid of diagrams.—*Elek. Zeit.*, October 4.

Comparison of Resistances.—Smith.—The first part of an illustrated report on high precision methods used by the British National Physical Laboratory, for the comparison of resistances.—Lond. *Elec.*, October 5.

Percentage Error.—Solomon.—An article on the calculation of the percentage error of measuring instruments. The author emphasizes that there are two different definitions of the same, one referring to the figure given by the instrument and the other referring to the figure of absolute accuracy. The author strongly prefers the former method, since in this case the figure giving the percentage error can be applied directly.—Lond. *Elec. Rev.*, October 5.

Electrical Measurement of Time Intervals.—Steidle.—A long abstract with illustrations of his recent German paper on a condenser method of measuring very small intervals of time, and some of its applications.—Lond. *Elec.*, October 5.

Analyzing a Periodic Curve.—Haga.—A simple graphical arithmetical method for resolving a periodic curve into its fundamental sine wave and higher harmonics, according to Fourier's theorem.—*Elek. u. Masch.*, September 23.

Telegraphy, Telephone and Signals.

Resistance of Conductors to Variable Currents.—Brylinski.—With reference to problems of wireless telegraphy, the author deals at length with conductors of indefinite extent, like the earth's crust, and shows that the surface density of the current is the smaller the greater the damping of the current. But, though the depth of the conductor be infinite, the density of the surface current is a finite fraction of the total current. Whatever may be the finite value of the damping, the distribution of the current is practically always superficial. But the current density does not decrease uniformly, there being several zones of rapid decrease separated by zones of slow decrease, thus making the total conduction a phenomenon of considerable complexity. Numerical data are given.—*Bull. Soc. Internat. des Elec.*, June; Lond. *Elec.*, October 5.

Telegraphy.—Knopf.—A communication from the telegraph experimental station of the German Government, describing an improved method of connecting the storage batteries used in telegraph stations.—*Elek. Zeit.*, October 4.

BOOK REVIEWS.

Continuous-Current Armatures. By C. Kinsbrunner. New York: D. Van Nostrand Company. 80 pages, 79 illustrations. Price, $1.50.

This little volume treats of the winding and construction of continuous-current armatures. The treatment employed by the author is descriptive rather than explanatory, although a brief discussion of the laws relating to the production of e.m.f. is included in the introductory matter, and more than half of the book is devoted to a chapter on the theory of windings. The element of brevity which characterizes the treatment adds to rather than subtracts from the value of the book for students and designers. Both the descriptive and the explanatory matter are restricted to windings which are commonly employed, so that the lengthy treatment which so frequently accompanies the discussion of special and unusual forms has been entirely omitted. The practical equivalent of the omission has been supplied by a brief outline discussion of the general formulas relating to armature windings, so that the average reader will be able to analyze any special winding that he may encounter, and the average designer will be able to obtain a winding suitable for any special conditions which may arise in practice.

Alternating-Current Windings. By C. Kinzbrunner. New York: D. Van Nostrand Company. 80 pages, 89 illustrations. Price, $1.50.

Although there is an endless variety of winding combinations that may be employed in alternating-current machinery, the fact remains that the forms actually used consist of certain definite

arrangements that may be placed in a limited number of classes. The author of the present volume has been fortunate in his selection of classes which seem to cover practically all forms ordinarily encountered. Twenty-seven pages of the book treat of the theory connected with the production of alternating e.m.f's, while 45 pages are devoted to descriptions of the most familiar types of single-phase and polyphase windings. The remaining pages deal with the discussion of the materials used in insulating alternating-current windings. In a table relating to 14 different materials it is shown that the dielectric strength varies from 1,450 per mm. for ordinary paper to 28,500 per mm. for ebonite—the unit of strength not being specified. The mechanical properties of several of the materials are outlined and the methods of applying the insulation are briefly discussed. On account of the scarcity of reliable information on the exact dielectric strength and mechanical properties of insulating materials the author's outline forms a valuable portion of the book.

The several articles recently published by the author on the subject of high-tension insulating materials furnish sufficient evidence to justify the statement that the value of the book to the designer would have been much increased had he chosen to discuss this subject at greater length.

A Recording Instrument.

BY C. E. VAWTER, JR.

The instrument herein described is adapted to be used with voltmeters, ammeters, wattmeters, gauges, pyrometers, thermometers, tachometers, dynamometers and, in fact, any meter having an index which is arranged to move over a scale.

The features to be embodied in the design of a reliable recording instrument for all industrial purposes may be summed up under the ten following heads: 1. The recording pen, located at the end of a long index, should have no frictional resistance due to contact with the record-sheet. 2. The index should be dead-beat or aperiodic. 3. The movement of the clock-work should not be impeded by having to move a record-sheet, thus preventing its keeping perfect time. 4. The record-sheet should be in view while, and after, making. 5. The record-sheet should be easily detachable and replaceable. 6. The mechanism of a delicate meter should not be impaired by the act of making a record. 7. It should be certain in its action. 8. It should be accurate. 9. The cost of maintenance should be very low. 10. The rate, at which the record-sheet moves, should be constant when in use and yet adjustable to any desired speed.

These, and other advantageous features are possessed by the instrument of which the following is a brief description:

Figs. 1 and 2 are photographs of a model of the instrument which has been thoroughly tested as to these requirements.

Fig. 3 is a side elevation of the instrument with case cut away. An electromagnet, 10, is placed under pen, 3, at end of the index, 4, the said pole-pieces being so shaped as to give a uniform magnetic field throughout the arc in which the pen moves. On the right end of the index is formed an aluminum collar into which is fitted a conical aluminum fountain pen, under which is fixed a thin soft iron armature.

A record-sheet passes between the pen and the pole-pieces. A section of a record-sheet upon which a record has been made is shown in Fig. 4. The rollers, 17, draw the record paper between them at a uniform rate by aid of a pawl, working on a ratchet-wheel to which the rollers are geared, and which is operated by the electromagnet, 15. A clock-work, to be placed at 11, simply makes contact at equal intervals of time between two platinum points at *k*, one of which is fixed to an arm on the balance wheel of the clock-work.

The position of the end of the index, 4, as it occupies various locations along its arc, is recorded by the attraction of the armature at the end of the index when a current is sent for a short interval around electromagnet, 10, thus pulling the point of the fountain pen into contact with the record paper. Two or three dry-cells in series are connected to the binding posts, *a* and *g*. When contact is made at *k* a current flows from *a* to *b*, thence to *c*, through *k* to *d*, thence around 15 and to *g*. The passing of the current around 15 pulls down arm, 12, thus causing the record-sheet to move forward a fixed distance at each contact. When arm 12 is pulled down contact is made at *p* and current flows from *a* to *b*, through magnet 10 to *e*, through *p* and thence through *f* to g. On account of this action the pen is brought into contact with the record-sheet.

The ten requisites, mentioned at beginning of article, of a reliable recording instrument, are accomplished in the following manner taken in order: 1. The index is left free to move

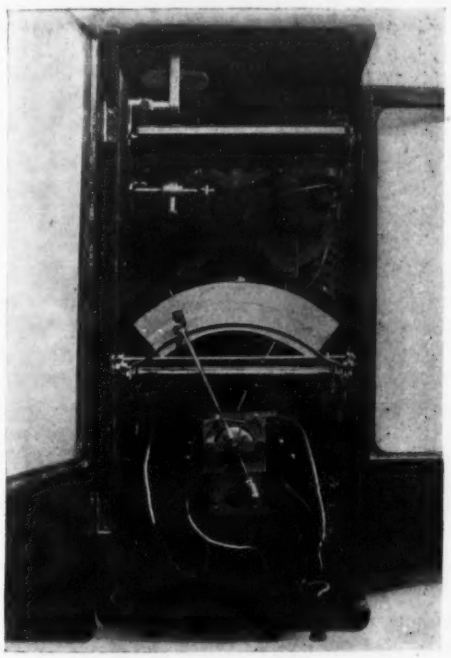


FIG. 1.—TOP VIEW OF INSTRUMENT.

between the intermittent contacts. 2. The frequent contacts, every half second if required, of pen makes the index aperiodic. The index as a whole is very light, has small moment of inertia and is quick in action. 3. The clock-work simply makes contact at *k*, and its accuracy is unimpaired. 4. The record-sheet while, and after, making may be viewed through a glass cover. 5. A new roll of record paper may be easily placed on the cylinder and completed records may be torn, or cut, off as they pass out at the end of the case. 6. The slight motion transmitted through the mechanism of the index will not impair the most delicate meter. 7. Contact at *k* and *p* is held for an appreciable interval, thus insuring its making. The mechanism of the index is

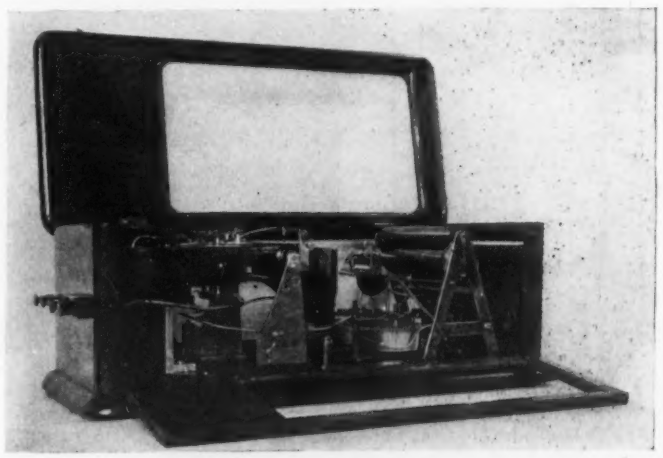


FIG. 2.—SIDE VIEW.

certain in action; and as a whole the apparatus is not liable to get out of order. 8. The electromagnet, 10, has two pole-pieces so shaped as to give a uniform field at the armature of the index in any position. By increasing or decreasing the air-gap, filled with lead, between pole-pieces, the strength of the field may be decreased or increased at any point along the arc as desired. The securing of a uniform field is absolutely essential in order to pull the index down vertically with no horizontal motion due

to the act of recording. 9. The cost of replacing the record-rolls and the dry-cells is practically negligible. 10. The record-sheet moves equal distances for each contact of clock-work. Its speed may be varied by changing the gears connecting the ratchet-wheel and the rollers or by altering the frequency of contact at *k*.

The instrument, as it is being manufactured, has been changed slightly in detail in order to simplify the mechanical construction, but the operation is as described above.

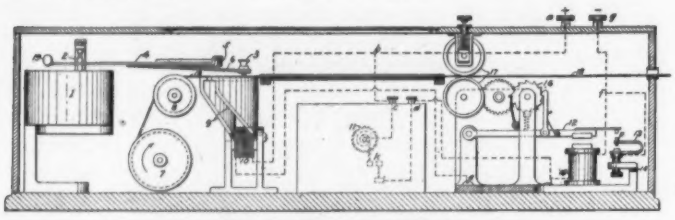


FIG. 3.—SIDE ELEVATION.

It has an almost unlimited application with voltmeters, ammeters, wattmeters, gauges, dynamometers, tachometers, etc., in power-stations and testing laboratories; with thermometers and pyrometers in the canning and packing industries; with tachometers in recording the speed of trains, steamships, etc., and for a number of other industrial purposes.

Electrical Equipment of a Modern Steam Laundry.

The Guthman Steam Laundry at Atlanta, Ga., presents an interesting example of the use of electricity. The building in which the work is carried on was built especially for the purpose and is entirely self-contained, being a brick structure of three floors and a basement, comprising some 24,000 sq. ft. of floor space. The arrangement of the processes in washing and ironing the clothes are somewhat unusual. The basement contains the generating equipment, repair shop and storerooms, while the primary washing machines and centrifugals for extracting water from the clothes are located on the top floor, which is, on this account, constructed of cement 14 in. thick. In this way the first and second stories used for offices, ironing and drying, are kept entirely free from all odors of boiling clothes and soapsuds, which will permeate any building in which the washing is done in the basement.

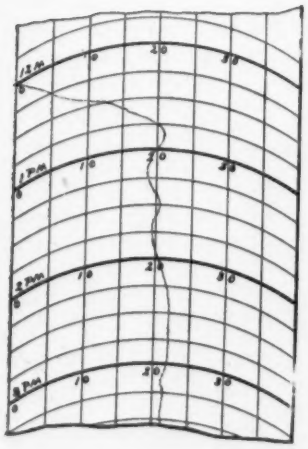
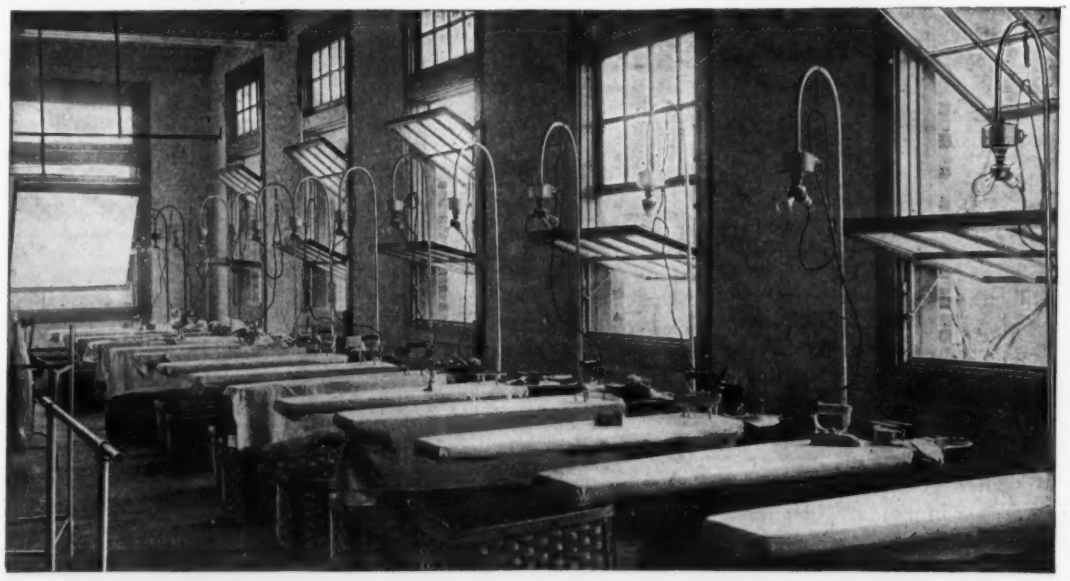


FIG. 4.—RECORD SHEET.

In the basement boiler room are located two 200-hp water-tube boilers which supply steam at both low and high pressures, respectively, for laundry purposes, and for an automatic engine which drives a 55-kw compound-wound, 110-volt generator for supplying light and power. On the first floor, in addition to the general offices, are four large mangles each driven by a 5-hp direct-connected motor. Individual motor drives are also used on the shirt bosom ironers, body ironers, wristband ironers, moisture applying machines, etc. The primary washing machines on the third floor, as well as the centrifugals, are grouped and are driven from two lines of shafting, each belted to a 15-hp motor. Aside from the machine drives, there is also installed an electric elevator which carries the work from the delivery wagons in the basement to the sorting room on the top floor.

It is in the hand-ironing department on the second floor, however, where the most interesting use of electricity is evident. Here are installed thirty six-pound and ten three-pound electric flatirons of the cartridge type. The method of installation is unusually neat and emphasizes the convenience and adaptability of the electric flatiron over the cumbersome gas-heated iron. Over each ironing table, as shown in the accompanying illustration, there is a special goose-necked fixture fitted with a 4-cp indicating lamp, controlled by the iron switch. This novel arrangement tells at a glance which irons are doing useful work or which are standing idle with the current turned on. Moreover, this method of attachment allows the operator the greatest freedom in the use of the iron.



ELECTRIC IRONS IN LAUNDRY.

The entire electrical equipment of this laundry was installed by the General Electric Company after plans of Mr. George Wade as consulting engineer for the Guthman Company. It has been demonstrated by the Guthman laundry that by the use of the electric irons 20 per cent more work can be accomplished by each operative per working day than that formerly done by the older methods.

Decorative Lamp Outfits.

A neat and compact outfit for decorative lighting is that which has recently been put on the market by the Sterling Electrical Manufacturing Company, of Warren, Ohio, and is styled by it "Winking Fairy Lights." This outfit consists of a carefully-made dove-tailed slide top, outer case of very careful construction and handsome appearance. The two ends and two sides of this case have a well-designed and executed cover or label in three colors and gold. The name of the outfit is carried out in this design in a very attractive manner.

The contents of the outfit consists of four specially made dry cells, a festoon of fine braid-covered wire, and black hard rubber receptacles for holding the electric incandescent lamps. The lamps for this outfit are special tantalum filament lamps.

One of the most attractive features of this outfit is that it is designed for the lamps to burn in multiple, so that if anything should happen to one of the lamps, it does not affect any other

of the lamps. A further attraction is the fact that it is arranged with an electric thermostat flasher, that causes the lamps to flash on and off, or "wink," from which it is given the name "Winking Fairy Lights."

The outfit is arranged for eight of these lamps, and contains two extra lamps to be used in case of accident to any of the others.

Oil-Insulated Water-Cooled Transformers.

The Allis-Chalmers Company, of Milwaukee, which manufactures a full line of power transformers, states with pardonable pride that, although these are installed throughout the country, "There has never been a breakdown in one of the transformers, nor has the company failed to meet its guarantees in any particular.

Much has been written about the relative fire risks of air-blast and oil-filled transformers, but this is a matter that depends as much on surrounding conditions and the location of the transformers as on the construction. The air-blast transformer contains a small amount of inflammable material as compared with the oil transformer, but this material is much more easily ignited. A breakdown in an air-blast transformer is usually followed by an electric arc that sets fire to the insulating materials, and the flame spreads under the action of the forced circulation of air. Although the fire is of comparatively short duration, it is quite capable of igniting the building unless everything near the transformers is of fire-proof construction.

The chances of an oil-filled transformer catching fire on account of any short-circuit in the windings are extremely small, because oil will burn only in the presence of oxygen, and, as the transformer is completely submerged in oil, no air can get at it. Moreover, the oil used in transformers is not easily ignited; it will not burn in open air unless its temperature is first raised to about 400° F., and with the oil at ordinary temperatures a mass of burning material can be extinguished as readily by immersing it in oil as in water. In fact, the chief danger of fire is not that the oil may be ignited by any defect or arc within the transformer, but that a fire in the building in which the transformers are installed may so heat the oil as to cause it to take fire.

Allis-Chalmers oil-filled, water-cooled transformers are placed in boiler plate tanks, cylindrical in form and provided with a substantial cast-iron base and cover. The tanks, which are riveted and calked, are supplied with eyebolts extending from the cover to the base, so that the transformers as a whole can be lifted without straining the tank. The cooling coils are made of 1¼-in. seamless copper or brass tubing, without joints throughout the portion immersed in the oil; all coils are tested with a water pressure of 200 lb. per square inch.

With coils constructed in the usual manner it is very difficult to drain all the water from them, and trouble has been caused in some cases by water freezing and bursting the pipe. This has usually occurred either during shipment or some time before the transformers have been placed in operation. In order to avoid this and also the danger of condensation on exposed parts not covered by oil, the ends of the cooling coils in our transformers are brought out through stuffing boxes arranged below the surface. The lower end is thus below the level of the lowest coil, so that all water can be easily drained off. The coils are permanently fastened to the case and are of such diameter that the transformer can be lifted out without disturbing the coils or water connections. Water-cooled transformers are supplied with an oil gauge, drain valve and thermometer with contacts for an electric alarm attachment that gives a signal in case the temperature exceeds the allowable limit.

All transformer coils are wound with double cotton-covered strip copper, one turn per layer, with fullerboard insulation, in addition to the cotton covering, between turns. Exceptions to the foregoing are made only when the size of the conductor is so small as to make this construction impracticable, and in such cases the coils are wound with round double-cotton covered wire with few turns per layer, so that the voltage between layers is kept within safe limits.

The primary and secondary windings are subdivided into a number of thin flat coils which present large cooling surface to the oil. When the coils are assembled the primary and secondary sections are interleaved, as shown, in order to reduce magnetic leakage and secure good voltage regulation.

When the conductor is large several strips are used in parallel and insulated from one another to prevent eddy currents. The coils are neatly and tightly bound with extra long linen tape, and no varnish or insulating compounds are used on the windings. Such materials deteriorate with continued use in hot oil, and in many cases are the cause of a deposit on the water-cooling coils or on the bottom of the transformer.

The transformer core is built up of selected sheet steel 0.014 in. thick. In larger sizes space blocks are placed every few inches in the core, thus providing ducts through which the oil can circulate and carry off the heat. Fig. 2 shows the coils and core of a standard transformer completely assembled.

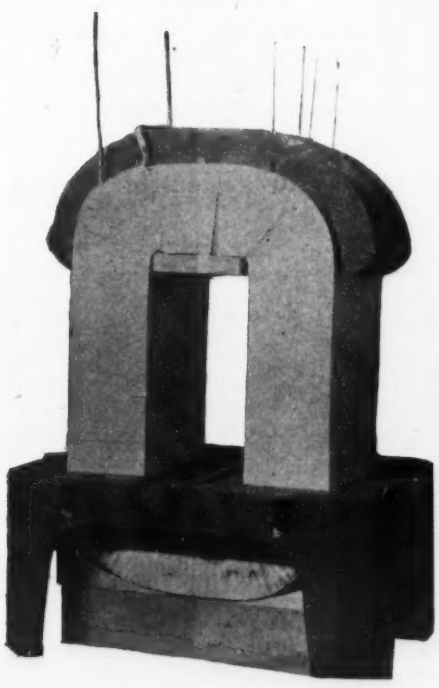


FIG. 1.—WINDINGS OF OIL-FILLED TRANSFORMER.

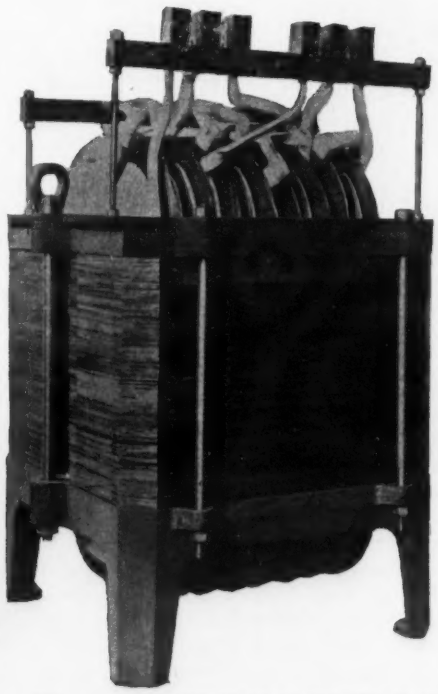


FIG. 2.—CORE AND COILS OF 500-KW TRANSFORMER.

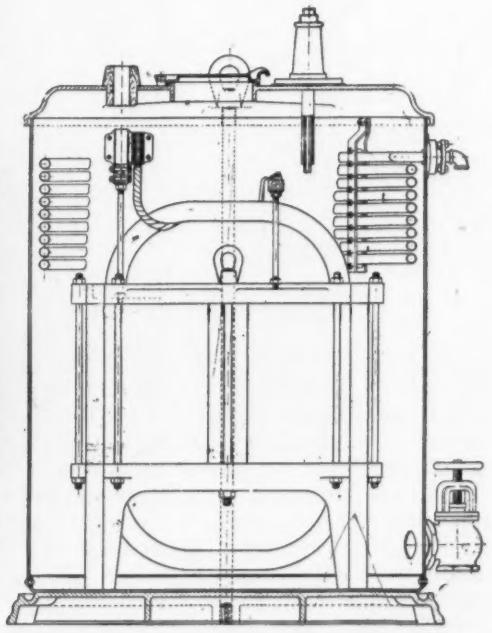


FIG. 3.—CROSS-SECTION OF TRANSFORMER.

Application of Ball Bearings to Motor Shafts.

Figs. 1 and 2 show ball bearing mountings for horizontal and vertical motors, respectively. The section at the left of Fig. 1 is for the pulley end, while that on the right is for the commutator end. In the former the outer race is not confined sidewise, whereas it is thus confined in the latter case between a shoulder in the casing and a lip of the end cover; the clearance shown exceeds by a slight amount the desired end play of the armature. Where no such end play is wanted the outer race is firmly clamped sidewise. The ball bearing at this end, therefore, takes whatever end thrust there may be. In other respects the mountings are identical, the important feature being that the inner race is given a light driving fit on the shaft and is further secured against any possibility of endwise shifting by binding it between shoulders on the shaft and a nut, or in the case of the pulley end, by a distance piece whose outer end comes up against the hub of the pulley, which it is assumed is fixed endwise.

An advantage that attends the use of these bearings is that the feature of non-wear makes it possible to make them oil and dust-proof without the usual complications of centrifugal oil slingers, catch basins, guards, etc. The arrangement shown has been widely adopted and consists merely of two concentric lips that are bored out not more than 1/64th in. in diameter larger than the shaft and are separated by a cored annular groove. The integrity of this closure is dependent upon the narrowness of the space between the lips and the shaft, and if bored larger the object is defeated. It will be noticed that the amount of space occupied lengthwise on the shaft, including oil closures, is small. As referred to the shaft diameter this will vary from one and one-half diameters in the case of small machines to less than one-half diameter in large machines.

Fig. 2 shows a form of mounting for vertical motors. It is differentiated from the horizontal mounting simply by the introduction of devices for keeping sufficient lubricant in the bearing to permit the balls always to dip through it. Instead of mounting the inner race directly on the shaft it is carried by a sleeve that leaves an annular space around the shaft into which there projects upward a cup firmly attached to the motor frame and that will allow the oil to leak out. In the case of smaller machines or of machines whose speed is materially above 1,500 r.p.m. the weight of the armature is taken on the radial bearing as shown in the upper portion of the engraving. This would usually be the one that does not receive at the same time the direct pull of the belt or thrust of the pinion if a geared motor is in question. For slower speed motors or for those in which the weight would exceed the carrying capacity of the radial bearing an extra ball thrust bearing is employed to take the weight.

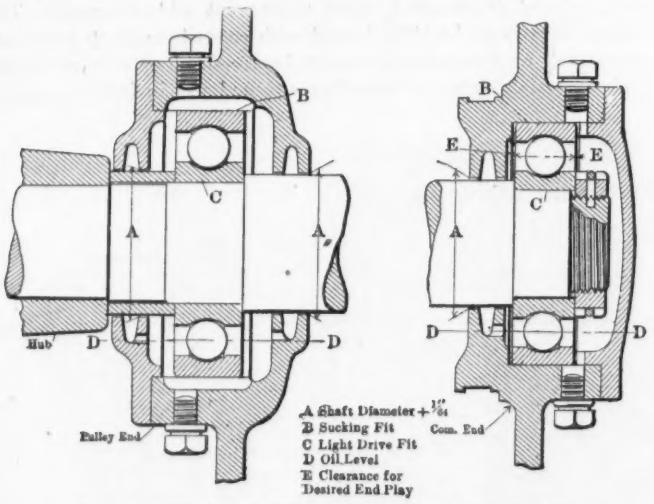


FIG. 1.—BEARINGS FOR HORIZONTAL MOTOR-SHAFT.

These bearings were originated in Germany and naturally have found more extended use there than here because of the short time since they were introduced in this market. In quite a number of cases these bearings sustain loads per journal of 22 tons at 600 r.p.m., and of six tons at 1,200 r.p.m. It is not the improved efficiency resulting from the practical absence of journal friction that is considered of so much importance as the absolute reliability in operation that they have shown, particularly at starting after a period of rest. With plain bearings the weight forces out the lubricant so as to necessitate very careful starting to prevent seizure. With smaller motors, however, the question

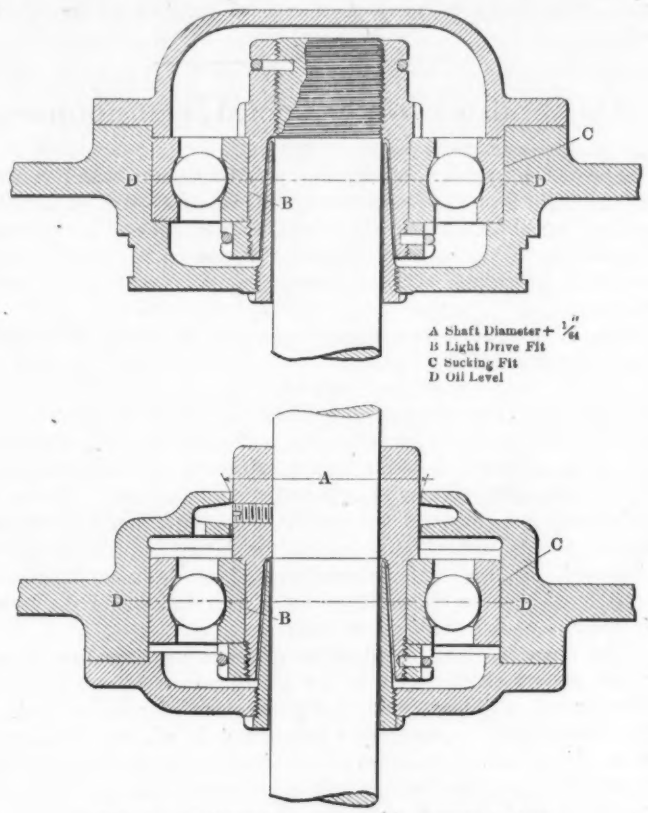


FIG. 2.—BEARINGS FOR VERTICAL MOTOR-SHAFT.

of efficiency becomes of greater importance, especially at outputs below normal when the general efficiency is poor. The saving possible with ball bearings very soon equals not merely the increased cost of bearings, but the cost of the motor itself, the increased cost of the bearing being but an insignificant portion of even the first year's saving. The bearings are marketed by the Hess-Bright Manufacturing Company, of Philadelphia, Pa.

The Muscle Shoals Hydro-Electric Power Enterprise.

The Muscle Shoals Hydro-Electric Power Company, with a capital stock of $1,000,000, has been incorporated at Montgomery, Ala., by Frank S. Washburn, of Nashville, Tenn.; Charles U. Baker, No. 100 Broadway, New York City; William H. Lindsey, of Nashville, Tenn.; J. W. Worthington, of Sheffield, Ala., and Massey Wilson, of Montgomery, Ala. Messrs. Washburn and Baker are the parties chiefly interested in the enterprise. Mr. Washburn has been connected for years with important canal, water supply and power enterprises in various countries. He was consulting engineer to two Isthmian Canal syndicates, and to the largest water and power interests in the State of California. As constructor he built a number of the largest existing dams and reservoirs. He is president of the second largest electric mining machinery manufacturing company in this country, and is largely interested in coal mining as well. Mr. Baker will be recalled as the engineer who projected and built and is now the principal owner of the noted Snoqualmie Falls and White River power developments, which supply electrical energy to Seattle, Tacoma, Everett and other places in the Puget Sound country for lighting, traction and general power purposes.

The project of the Muscle Shoals Hydro-Electric Power Company may be briefly described as follows: It is proposed to span the Tennessee River by two masonry dams, of a maximum height of 60 ft., the lower one being located at the foot of the Little Muscle Shoals and the upper at Florence, Ala. These dams, by backing up the water of the Tennessee River, will make available the entire fall of the Big and Little Muscle Shoals,

making practicable a development of 100,000 hp. Each dam includes as an integral part of itself a boat lock for facilitating navigation on the Tennessee River. The company's plans will very much expand the possibilities of river commerce and will have the co-operation of the Government on account of the improvement to be thus afforded over the present canal and lock facilities at that point.

A substantial power house with a full complement of water wheels, generators and transformers will be built below each dam. Power transmission lines will be built radiating from the generating stations to such places within a 100-mile radius as will be benefited by the introduction of the service. Such places will include Nashville, Huntsville, Decatur, Birmingham and other places as well as isolated cotton mills and other large industries. The company has acquired title to all lands necessary for the location of its dams and power houses, together with such other lands and water rights as are made necessary by the enterprise.

Electrical Installation in Shipbuilding Shop.

The Harlan & Hollingsworth Corporation, of Wilmington, Del., has recently installed a very complete electric light and

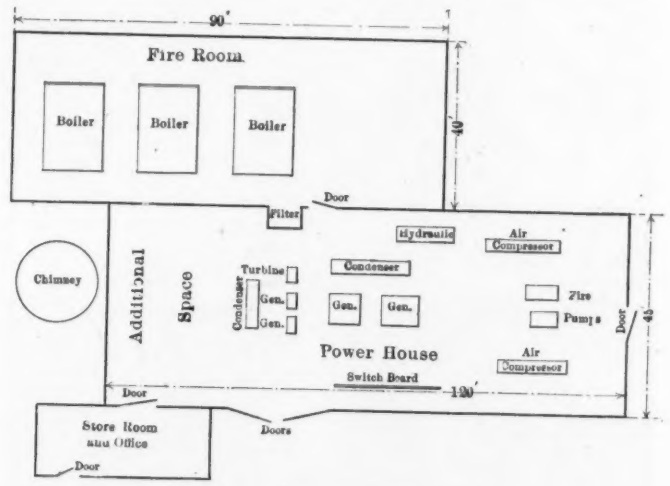


FIG. 1.—PLAN OF POWER HOUSE.

power plant, all of the work being done by the electrical department of the works. There are two 300-kw General Electric

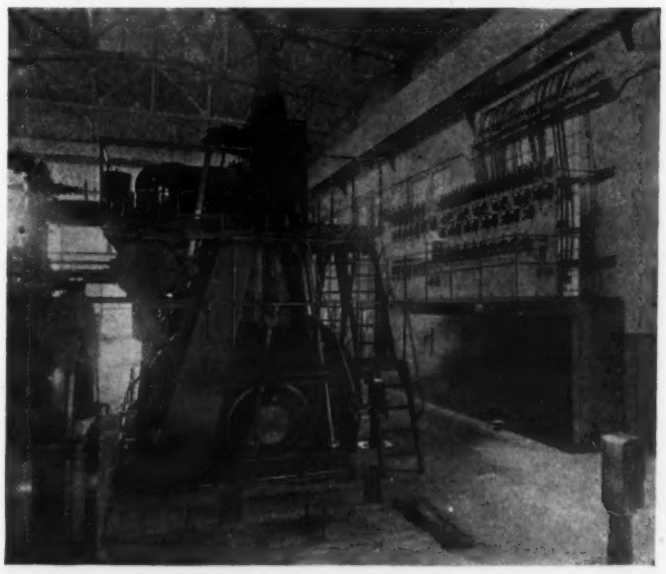


FIG. 2.—VIEW OF INTERIOR OF POWER HOUSE.

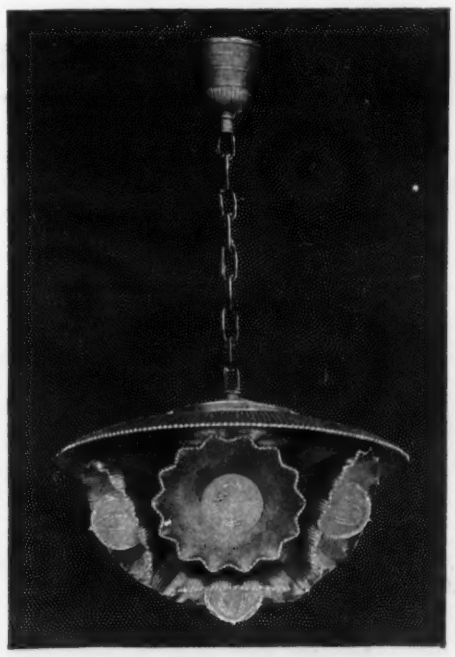
generators which deliver 250 volts direct-current from a commutator and 125 volts between each lead and the neutral point. The neutral point is obtained, according to the Dobrowolsky system, by tapping from the neutral points of two auto-transformers connected between four taps on the armature winding. Each of the above machines is driven by a 15-in.x32-in.x30-in. stroke McIntosh & Seymour cross-compound vertical engine running at 150 r.p.m. The station contains also a 150-kw unit consisting of two 75-kw, 125-volt machines connected in tandem, and driven by a Curtis horizontal turbine running at 2,400 r.p.m. The various shops are equipped with motors ranging from 1 hp to 140 hp, some of which are constant speed, and others of variable speed to suit the requirements of the machine they operate.

The line work is of good substantial construction, some of the cables being 1½ million circular mils in section. The switchboard, which is of marble, consists of three machine panels, one recording and six two and three-circuit panels. General Electric static voltmeters and ammeters are used, and Thomson watt-hour meters.

The fire room contains three Sterling water-tube boilers and space for one additional. Steam is generated at 150 lbs. pressure. The system is operated condensing. There are also operated in conjunction with the electric plant two air compressors, cross-compounded, a hydraulic pump, and space is provided for two fire pumps. The buildings are constructed of concrete.

Holophane Clusters.

The Holophane Glass Co., 227 Fulton St., New York, is placing on the market the type of incandescent lamp cluster shown in the accompanying illustration, the trade name being "Reflecting Arc." The cluster utilizes the new high efficiency



LAMP CLUSTER.

lamps of 40 cp, consuming 100 watts per lamp. The 6-lamp cluster, therefore, consumes practically the same power as a 5¼-amp., direct-current enclosed arc, but it is claimed gives more and better illumination combined with a fixture of artistic appearance. This cluster is made up with 4, 5 or 6 lamps.

Methods in a Large Repair Shop.

The Gregory Electric Company, of Chicago, has recently moved into a new plant at Sixteenth and Lincoln Streets, away from the congested districts of the city. It is of interest to note some of the methods and other points of interest in connection with the largest establishment for dealing in and repairing second-hand

electrical apparatus in the West. The new plant has a floor space of 30,000 sq. ft., to which 30,000 more is to be added next year and its general construction follows that of many modern factory buildings. There is a traveling crane down the center for handling the heaviest apparatus, as shown in Fig. 1. On one side of the central bay spanned by the traveling crane is the machine shop and winding department (Fig. 2). On the other side

FIG. 1.—VIEW DOWN CENTRAL BAY.

are stores and supplies and the testing floor (Fig. 3), where dynamos and motors are tested under load. About 125 men are employed.

The business of this concern is peculiar in that unlike a manufacturing company it must be prepared to deal with and repair a great number of different makes and sizes of electrical apparatus. It also differs from a business of purely buying and selling second-hand apparatus in that nearly all of the apparatus which passes through the establishment has to have some work done upon it because all apparatus is guaranteed for a certain number of months after it leaves the shop, provided, of course, it receives proper and reasonable treatment. Besides this considerable repair and alteration work is done. As an example of this a few years ago the changing of old-fashioned smooth-core alternators to slotted type armatures with a resultant great increase in capacity was a very common piece of alteration work. Now that second-hand high-frequency alternators are sold at such low

FIG. 2.—MACHINE SHOP AND LATHE MOTOR EQUIPMENT.

prices there is less inducement for a central station company to have such an alteration made on a machine, as it is coming to be practically as cheap to buy a larger second-hand machine as to alter an old machine to increase its capacity.

The repair department takes care of transformer winding, armature winding and the repair and testing of indicating and recording meters. All of the machine tools in this department have individual motor drives. The method of applying motors to lathes is shown in Fig. 2. The motor is mounted on top of the lathe and the first gear reduction is obtained through a Renold silent chain. The motor is of the "interpole" type, which gives a wide range of speed variation without sparking. The controller is of the Cutler-Hammer type with the rheostat mounted on the tail end of the lathe. A square rod running the length of the lathe parallel with the tool guides operates the controller. On this rod is a handle which can be slid along to any point desired by the workman. The motor is provided with a small circuit-breaker mounted alongside the main switch and fuse near the motor. A shaper is driven by a motor which reverses at the end of each stroke instead of having the reverse accomplished by mechanical means. Two coil-winding machines are employed, each driven by a 1-hp motor. The spindle on which the winding form is placed is connected with the driving shaft through a friction clutch, as usual in such machines. This clutch is thrown into gear by a treadle.

The practice is to test rewound transformers with double the

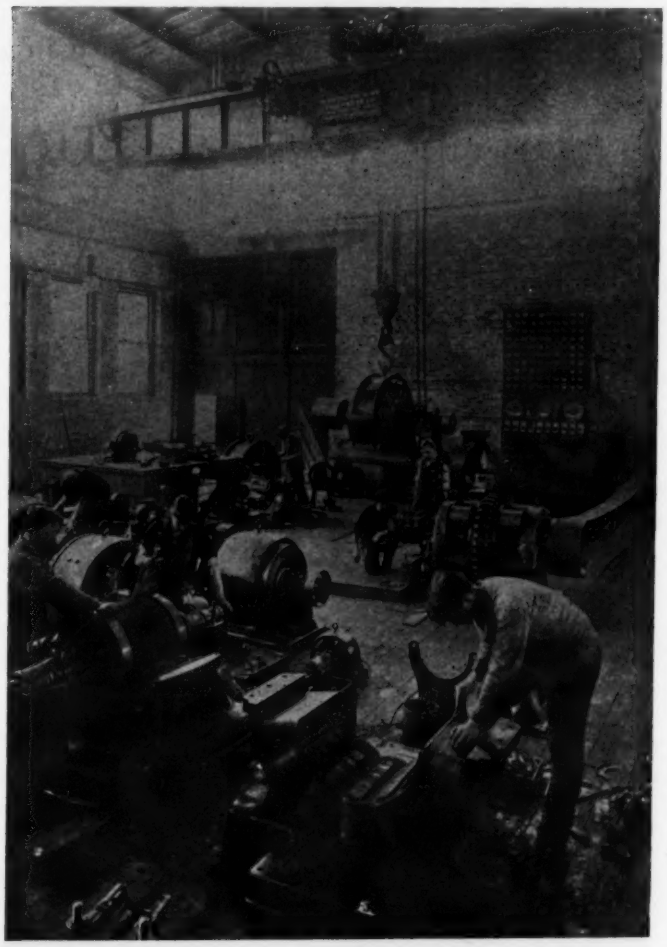


FIG. 3.—TESTING FLOOR.

working voltage of the coil under test. Thus, a 2,300-volt transformer is tested with 4,600 volts between primary and core and between primary and secondary. They are also operated at rated primary voltage with full load on the secondary for a few moments as a check on the work of the coil winders to determine whether there are any short-circuited turns and whether the voltage ratio is correct.

Most of the current for testing is supplied from the company's own plant on the premises. The regular shop circuit is 110-220 volts direct current, and 500 volts direct current is also obtainable. Single-phase alternating current of 60 and 133 cycles is obtained from the company's plant and three-phase, 60-cycle alternating current from the Commonwealth Electric Company's service. A high-speed engine of 100 hp direct-connected to its generator operates the shop. For testing purposes an engine of 175 hp is belted to a short line shaft from which dynamos under test can be driven. The driving pulleys are placed on the ends of this line shaft so that sizes of pulleys can be quickly changed

to test different machines. The testing platforms on which machines are set when under test are provided with perforated plates whereby any size of machine can be bolted down during the test. Each platform is provided with a belt tightener. An interesting feature of the testing plant is the water rheostats for loading different sizes of dynamos. These rheostats are in the shape of high wooden tanks, as seen at the left in Fig. 4. The highest tank, which is about 8 ft. high, can be used for testing arc light dynamos up to about 6,000 volts. At various points down the tank are voltmeter leads so that the voltage of the machine can be measured by adding the various voltages obtained between the terminals, thus avoiding the necessity of connecting a voltmeter across the terminals of the high-voltage arc light dynamo.

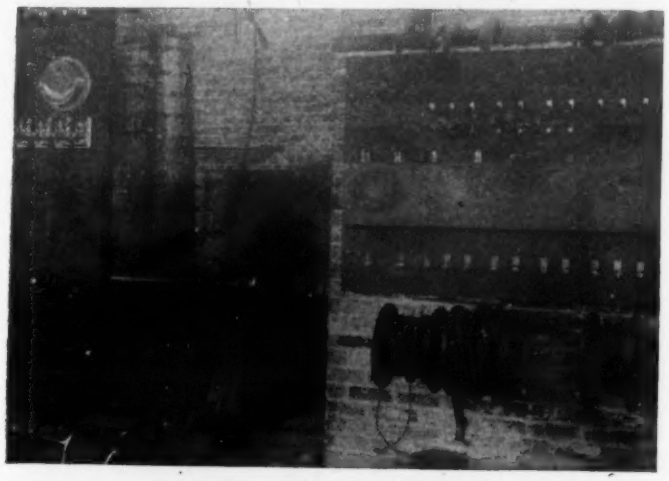


FIG. 4.—WATER RHEOSTATS AND MOTOR TEST BOARD.

The tanks are provided with plates which can be raised and lowered to alter the resistance. If the resistance of ordinary water is too high, as when testing low-potential machines, common washing soda is added to the water.

An interesting provision for the rapid testing of motors is the motor-testing board shown in Fig. 4. On this board are found all the different kinds of current with which the shop is provided. Each circuit first comes to a knife switch and then passes through fuses located in the box immediately under the switches. Below the fuse box is a row of terminals, and under these are reels of twin cable long enough to reach clear across the testing room. One end of the cable is fastened permanently to the reel and ends in binding posts on the outside of one end of the reel. As soon as the cable is unreeled to the proper point two short flexible connectors are placed between the binding posts of the cable reel and the proper terminals on the switchboard. The testing floor is served by a traveling crane. At one side of the testing room a switch track enters the building where material is loaded and unloaded from the cars. A loading platform alongside the railroad track is also provided. It is necessary to keep an immense stock of patterns of repair parts, and the company maintains its own pattern shop.

Equipping a Modern Cement Mill.

The Helderberg Cement Company, whose plant is situated at Howe's Cave, N. Y., about 30 miles south of Albany, on the Delaware & Hudson Railroad, has begun active preparations to enlarge its output of high-class Portland cement and to add extensively to the present properties. The additional power required will be produced by means of a 1,500-kw Allis-Chalmers steam turbine generator unit, the order for which was recently placed through Mr. Thomas E. Murray, consulting engineer, New York City.

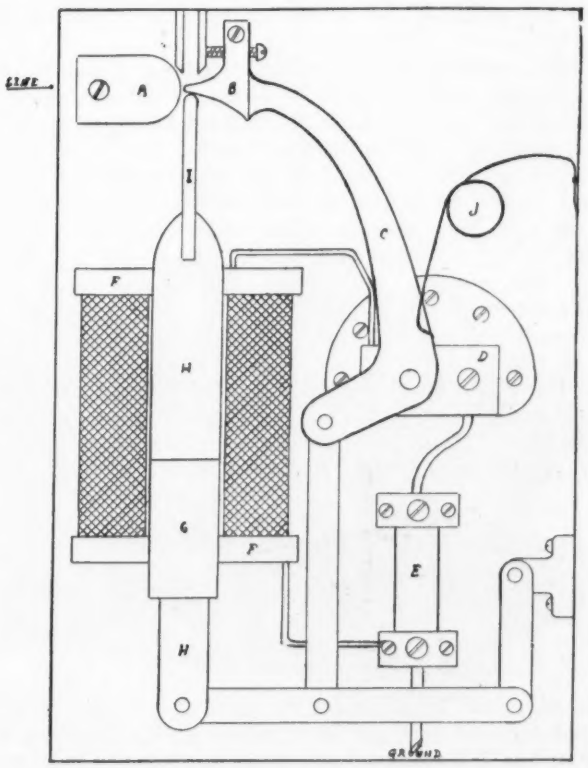
The old plant, which is driven by two 20-in. and 38-in. by 42-in. Dickson cross-compound condensing engines, built at Scranton, Pa., in the works now owned and operated by the Allis-Chalmers Company, has been in existence for a number of years, during which time it has enjoyed the increasing demand for its product which now makes necessary the enlarged facilities. The old engines, whose service will be replaced by the turbine unit, will be retained in the power house for use in an emergency.

The new unit will conform to the Allis-Chalmers well-known standard designs for both turbine and alternator, the latter being wound for 440 volts, 60 cycles, three-phase and to operate at a speed of 1,800 r.p.m. under a steam pressure of 150 lb. at 28 in. vacuum. A Tomlinson jet condenser with auxiliary air pump and accessories will also be furnished.

Circuit-Breaker Type Lightning Arrester.

The accompanying illustration shows a form of lightning arrester of the circuit-breaker type, which was first exhibited by the Oleson-Williams Co., of Toledo, Ohio, at the recent Columbus street railway convention.

The block *A* is connected with the trolley circuit. Between this block and the block *B*, which is mounted on the movable arm, *C*, is an air-gap, the length of which may be regulated. The lightning discharge is offered a ready path to earth through these parts and the graphite resistance plug, *E*. If the lightning discharge is greater than the carrying capacity of the graphite resistance plug, the excess is shunted across points which approach each other immediately under the graphite from the brass blocks holding the same. When the graphite is taxed to its carrying capacity it becomes an easier path for the lightning discharge to jump across the points, thus preventing the graphite from becoming charred or burned and putting a splendid insulator in the place where only a certain ohmic resistance was intended. In this manner the efficacy of the graphite resistance plug is preserved. The graphite used is of sufficiently low ohmic resistance to shunt just enough of the dynamo current through the solenoid, *F*, to magnetize it and pull up the core, *G*, which



CIRCUIT-BREAKER TYPE LIGHTNING ARRESTER.

is mounted on the wooden pin, *H*. By means of proper leverage this action throws back the pivoted arm, *C*, stretching out the arc. At the same time a slide, *I*, of incombustible insulating material mounted on the upper end of the pin, *H*, and just uncovering the block, *A*, moves up and takes its place in front of the block, *A*, thus cutting the arc as nearly instantaneously as possible. A spring, *J*, is so placed that its tension will become greater as the arm is thrown back, thus insuring a positive resetting of the air-gap after the arc is broken.

The advantages claimed for this device are the free path to earth offered to the static charge, the quick break of the dynamic arc outside of any enclosure which may become clogged by the

confined heat, the method of preserving the efficacy of the graphite resistance plug and the automatic action which requires no attention.

Interior Telephones.

The accompanying illustrations show three new types of interior telephone instruments which have recently been placed on the market by the Holtzer-Cabot Electric Co., of Brookline, Mass., and Chicago, Ill. They are built along lines similar to other standard instruments manufactured by the above company,

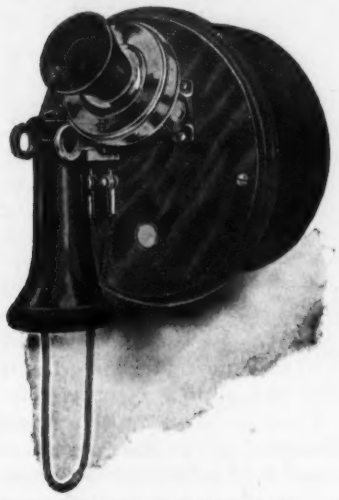


FIG. 1.—CIRCULAR FLUSH WALL TELEPHONE.

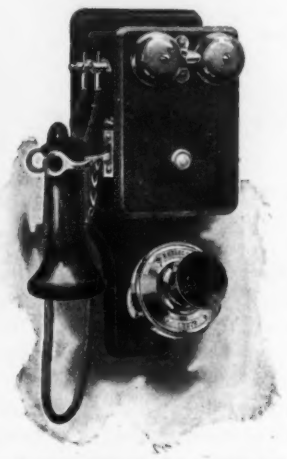


FIG. 2.—SCHOOL TYPE OF TELEPHONE.

and yet are distinctly new in the combination of the different parts which enter into their make-up.

The single point circular flush wall telephone is designed for use in locations where space is somewhat limited and where an instrument that protrudes from the wall would not be desirable. The working parts are enclosed in a metal case six inches in diameter which sets into the wall, allowing the face of the instrument to rest flush with the wall surface. The transmitter is of the solid back, granular carbon type, mounted on an adjustable bracket so that it may be used by persons of different heights. The receiver is of the standard bi-polar, enclosed terminal type, mounted in a hard rubber shell.

The single point, school type of telephone is one of the latest types of telephone instruments brought out by the above company. It will be found especially adapted for use in schools, hospitals and similar buildings. The equipment of the instrument is much the same as that of the flush telephone described above. A solid back, granular carbon transmitter is used, mount-

FIG. 3.—HAND MICRO-TELEPHONE.

ed on adjustable bracket, and the receiver is of the bi-polar, enclosed terminal type, in hard rubber shell. Standard battery telephone bells are used and a flush push button is provided for calling.

In the hand microtelephone there is a unique combination of a bi-polar, watchcase receiver and a granular carbon transmitter. The construction is such that when the receiver is held to the ear, the mouthpiece of the transmitter is in the proper position for speaking. The handle, which is of hard rubber, contains a push button which throws the batteries in or out of circuit at the will of the operator, thus prolonging the life of the batteries, as they are automatically cut out when the set is not in use. The instrument is solidly and durably built and yet may be readily taken apart for inspection or adjustment. The instrument is very neat in appearance and conveniently light to handle and should merit the approval of the users of telephone instruments in general.

Lamp Guards.

The accompanying illustrations, Figs. 1, 2 and 3, show a new lamp guard recently brought out by Harvey Hubbell, Inc., Bridgeport, Conn. The points of this guard are its simplicity and strength, the rigid way in which it is fastened to the socket shell, and the ample space between the outside of the guard and the lamp, the former not depending on the lamp bulb for support.

Fig. 1 shows a contractile collar, and an internal thread in the top of the guard. When attaching to the socket the collar is placed over the rib of the socket shell, then the guard is screwed on. This causes the collar to contract and hug the rib on

FIGS. 1 AND 2.—LAMP GUARD.

the shell, which makes an absolute lock, holding the guard just as rigidly as if it was part of the socket shell itself.

Fig. 2 illustrates the guard attached to the socket. This connection is made close to the neck of the lamp, which gives the rigidity just where it is needed. There is also plenty of space between the lamp and the guard, and the opening at the bottom is sufficiently large to insert a lamp. This rigidity combined with the ample space prevents the lamp from coming in contact with the guard, giving excellent protection and practically a positive one to the lamp. Fig. 3 shows the guard fitted with a Hubbell shade. The wire in all the guards is made from heavy stock, and owing to the nature of the fastening there is very

FIG. 3.—LAMP GUARD.

little of it required, consequently there is comparatively no obstruction to the light. They are made for both 16 and 32-cp lamps.

Blue Printing Apparatus.

The Revolute Machine Co., 523 West Forty-fifth Street, New York, is placing on the market the Everett-McAdam Continuous Electric Blue Printing Machine, shown in the accompanying illustrations. The machine consists of a rotating glass cylinder which lies in a series of narrow belts, and within which cylinder are placed two mercury-vapor electric lamps. The roll of paper to be printed is placed in a box on top of the machine and feeds in continuously between the belts and the cylinder; or, if only a few prints are wanted, previously cut sheets of paper may be fed in. The tracings are inserted between the paper and the

cylinder, and, after passing around three-fourths the circumference of the cylinder, are deposited with the paper in a box in the front part of the machine, the printing being done from the inside of the cylinder as the paper and tracings travel around it.

The machine is claimed to solve successfully the problem of continuous blue printing by electric light and to have many points of very decided advantage. It is possible to make prints five feet wide and of any length whatever, and the device is particularly adapted to making numbers of small prints on one long sheet of paper or on previously cut sheets—which come out in a regular stream—and of an absolutely uniform tone. One

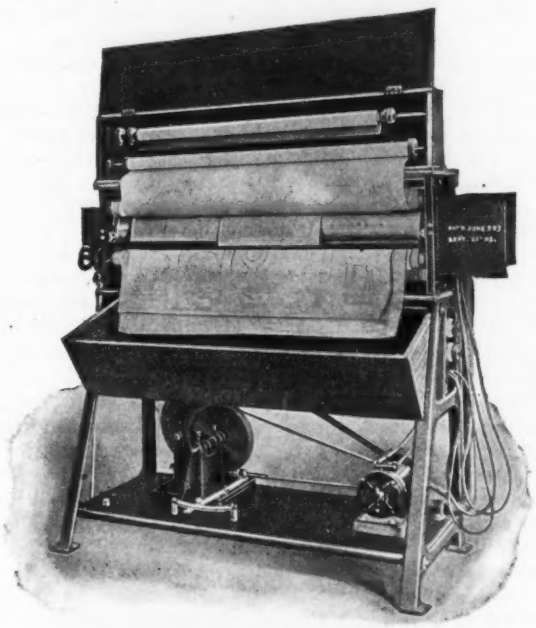


FIG. 1.—BLUE-PRINTING MACHINE.

great feature of the machine is that it is only necessary to handle one tracing at a time, the small ones being fed in side by side, while the paper feeds in automatically from a continuous roll.

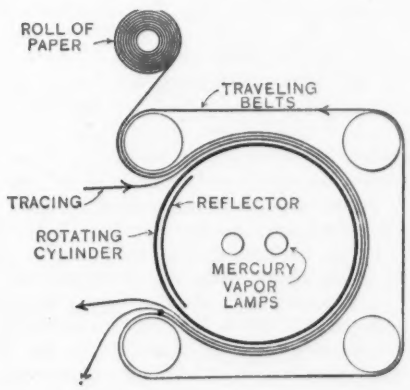


FIG. 2.—DIAGRAM SHOWING PRINCIPLE OF MACHINE.

The tracings go in and come out on the same side of the machine so that the leading edge of a tracing may be fed into the machine again before the trailing edge comes out, saving considerable time where more than one print is wanted from one tracing. This has been very nicely illustrated by making twelve prints from one 6-ft. tracing on a single sheet of paper 72 ft. long without wasting an inch of paper or a second of time between prints.

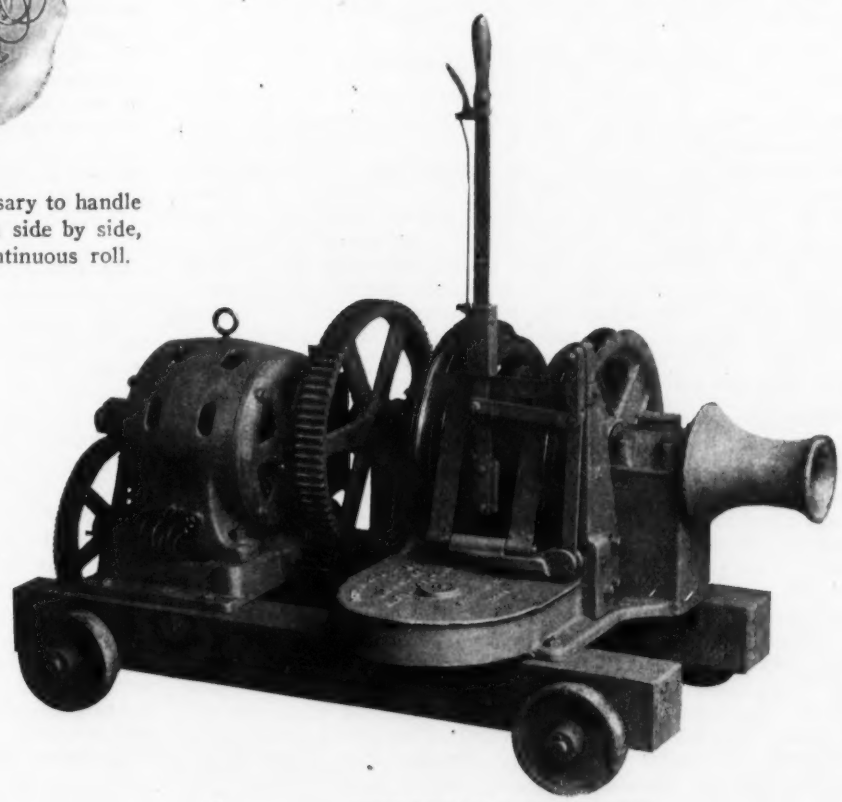
Another feature of the Everett-McAdam machine is the use of a number of 1½-in. belts instead of a single broad one. In this way perfect contact is obtained, which it is not possible to obtain with the use of a single broad one.

The lamps used are highly efficient in use of current and particularly adapted to this kind of work, as they give out a very large proportion of actinic rays; and as the printing is done from the inside of the cylinder, the light strikes the paper at the right angles. The machine is very compact, requiring a space only 2 ft. by 5 ft., and is entirely self-contained. It is driven by a motor and the speed can be instantly changed to any rate desired by moving a convenient lever.

A Single-Phase Builder's Hoist.

The single-phase builder's hoist shown in the accompanying illustration is manufactured by the Truxal-Painter Manufacturing Company, Chattanooga, Tennessee, and is designed especially for hoisting brick, mortar or concrete in wheelbarrows. The use of the single-phase motor gives the hoist a wide field of application owing to the great predominance of alternating-current lighting lines; moreover, the load is a day load never crossing the peak. In cities having only direct-current districts the single-phase motor can be removed and a direct-current motor installed in its place on the same base frame.

The hoist operates, by cable, two platforms moving side by side, one ascending while the other descends. By throwing a lever the driving sheaves on the hoist are started, stopped and reversed. The driving shaft runs continuously, the sheaves being thrown in and out by clutches. The brake is automatic. The arrangement of the sheaves on the hoist provides a novel and reliable method for securing reverse of the cable travel without reverse of the driving mechanism. Equipped with a 3-hp motor the hoist weighs 1,200 lb., has a lifting capacity of 500 lb. at a speed



SINGLE-PHASE BUILDER'S HOIST.

of 250 ft. per minute and will raise 50,000 brick with mortar per day.

Mr. R. L. Westcott, the contractor for the brick work on the new Nashville Railway Building, stated that with this electric hoist he raised 700,000 brick with mortar at a cost of $13 for the electric energy, or a little less than 2 cents a thousand. Had the hoist been worked to its full capacity 50,000 bricks a day could have been raised at a cost of 3 cents a thousand for wages of operator, who does not require to be a skilled man, making a total cost of five cents a thousand for energy and labor. Mr. G. H. Patten, for many years connected with the General Electric Company, has resigned to become secretary and treasurer of the company manufacturing the hoist.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Last week's reports of trade in general indicate unprecedented activity for this season of the year. In retail lines business has expanded, and the reorder demand from jobbers has consequently increased. On spring account much more business is being done. The Southern trade has been helped by higher prices for cotton, which have induced freer marketing and enlarged country trade and collections. From the central West and Atlantic Coast points, where weather conditions have improved, good reports are made. In the Northwest car shortage and overflowing country elevators are complained of as affecting the marketing of wheat. The grain trade generally complains of car congestion, which causes losses owing to delay of export business. The leading industries continue active. Higher premiums are being paid for what little spot iron can be obtained; rails are more active, and imports of foreign pig iron are increasing. It is stated that Bessemer ore will be advanced 75c. a ton next season, while non-Bessemer will be increased 50c. This, together with the higher price of coke, will mean an addition of 50c. to $1.00 to the cost of producing one ton of iron. Steel is generally scarce. The orders placed during the week for steel rails aggregated 170,000 tons and a large tonnage is pending. Lake shipbuilders have purchased plates and shapes quite heavily. Sales of structural material for buildings are of fair proportions, and business for bridge work is being freely placed. Refined copper has advanced to 22¼c., but little new business is doing owing to the scarcity of supplies. A number of large sales were effected by producers for account of home and foreign metal merchants and manufacturers who covered for January and February. There is no visible domestic stock of high conductivity copper. Demands for electrolytic and Lake have swept the markets bare of those grades for November and December. Producers' prices for large tonnages are: Electrolytic, January and February, 22½ to 23c; Lake, for the same months, 22½ to 22¾c.; casting stock, 22¾ to 25c. Aluminum is quoted at 36c. Railway earnings for October so far reported show an increase of 8.1 per cent over the business of last year. Voluntary wage increases are reported in numerous lines, but agitations for higher compensation are numerous among railway employees. The number of business failures during the week, as reported by *Bradstreet's*, numbered 184 against 170 the week previous and 178 in the corresponding week last year.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports a remarkable increase in its business since removing to its new works at Sixteenth and Lincoln Streets. Among recent shipments are the following: One 75-kw General Electric, three-phase alternator, Union Construction Company, Jamestown, Cal. One 9½ Brush arc dynamo, Board of Trustees, Madisonville, Ohio. One 50-hp Commercial motor, Chicago Brass Company, Kenosha, Wis. One 30-hp General Electric three-phase motor, John Spry Lumber Company, Chicago, Ill. One 45-kw Northern generator, Williamston Illuminating Company, Williamston, Mich. One 225-kw Westinghouse three-phase alternator, Electric Storage Battery Company, Philadelphia, Pa. One 150-kw Warren alternator, Johnston City Electric Light & Water Works, Johnston City, Ill. One 225-kw Westinghouse, three-phase alternator, P. E. March & Company, Ottawa, Ont. One 150-hp General Electric, three-phase motor, Brown Bros., Chicago, Ill. One 150-hp General Electric, three-phase motor, Griffin Wheel Works, Chicago, Ill. One 50-hp General Electric, three-phase motor, Muncie Electric Light Company, Muncie, Ind. One 50-hp Westinghouse, three-phase motor, 2,200-volt, Marion Light, Heat & Power Company, Marion, Ind. One 125-hp Westinghouse, three-phase, 25-cycle motor, United States Cement Company, Bedford, Ind. One 125-kw General Electric, three-phase generator. One 100-kw Siemens & Halske generator, Consolidated Gas & Electric Company, San Diego, Cal. One 75-kw Westinghouse, two-phase alternator, Mitchell Gas Company, Mitchell, S. D. One No. 9 Wood arc dynamo, Higginsville Electric Light & Power Company, Higginsville, Mo. One 60-kw General Electric alternator, American Express Company, Southampton, England.

POWER IN WASHINGTON.—The Chelan Electric Company, of which J. T. McChesney, of Everett, Wash., is president, has acquired riparian rights on the Chelan River between Chelan and Chelan Falls, west of Spokane, and will erect a power plant for the operation of electric railway from the town of Wenatchee northward along the Columbia River, with a branch to Lake Chelan, and up the Okanogan River to the northern boundary of the State. The power will also be utilized in supplying the town of Chelan with electric light and water and in lighting the towns of Wenatchee, Waterville, Orondo, Brewster and points along the Columbia River; also pump water for irrigating purposes from the Columbia River onto the available benches along that stream, and for the purpose of operating the line of the Great Northern from Wenatchee to Seattle, a distance of 160 miles, and for lighting the various towns along the way. The Lake Chelan Water Power Company, organized under Arizona laws, with $3,000,000 capital, has been incorporated in Washington. Its objects are to engage in general transportation, irrigation and mercantile business. The incorporators and officers are: James McMillan, of Minneapolis, president; Junious Bebee, of Wakefield, Mass., vice-president; Albert F. Helliwell, of Minneapolis, secretary and treasurer; Carrie E. McMillan and Charles F. Linnmayer, of Minneapolis. Branch offices are provided at Chelan, Wash.; Washington, D. C., Boston, Minneapolis and New York.

SPANISH NAVAL EQUIPMENT.—Spain is making rapid progress with the rebuilding of her navy. The expenditure of about $70,000,000, authorized by the Cortes last year, is being laid out to cover a construction programme of six years. It comprises eight 14,000-ton battleships, nine cruisers and several smaller vessels. Half the ships must be built in Spanish yards, and besides the construction now under way, a complete reorganization and equipment of the arsenals, docks and yards at Ferrol, Cadiz and Carthagena has been undertaken. Among other vessels now building are the Emperador Carlos V, a protected cruiser of 10,000 tons, three belted cruisers, Cardinal Cisneros, Cataluna and Princessa de Asturias, and the protected cruiser Reina Regenta. A contract which has just been signed in London for electrical power doors for the Reina Regenta, now nearing completion at Ferrol, shows that Spain intends to make her new warships as up-to-date as possible. Old-style bulkhead doors had been provided for, but when the authorities found out about the new method of closing watertight doors by electricity a change was promptly made. These power doors, known as the "Long Arm" system, are the invention of an American naval officer, and are installed on nearly all the new ships of the United States Navy. The object is to make ships unsinkable by providing this means of closing all their important bulkheads in time of emergency from an electrical central station located above decks.

POWER IN TENNESSEE.—Attention has been turned recently to the development of water power on the Little Tennessee River. The Knoxville Power Company, organized by local capitalists who have associated with them men of means in the East, now has a project under way looking to the erection of a power plant on the Little Tennessee, about forty miles from Knoxville. Electrical power will be transmitted to mills and factories at various East Tennessee points. It will also be available for lighting purposes. The company has a franchise in Knoxville, and it promises to consummate its plans within a short time. It is given out that the work of beginning construction of the plant is being delayed only until a railroad connection is completed to a point near the site, that materials may be shipped to it. This railroad is now under construction, being a part of the Bushnell extension of the Southern Railway.

CATALOGUES WANTED.—The Independent Electric Company, of El Paso, Tex., is engaged in the electrical contracting and supply business in that city. Mr. B. P. Dabinski is the manager. The concern wishes to receive catalogues, discount sheets, bulletins, etc., from manufacturers and electrical supply houses, as it is in receipt of requests for all kinds of supplies, machinery, etc.

LINE MATERIAL WANTED.—Mr. Chas. C. Stephenson, general manager of the Laurel-Seaford Electric Light Company, Laurel, Del., writes us that they have signed a contract for lighting the town of Bridgeville, Del., and will have to build a 10,000-volt transmission line from Seaford. The company is in the market for the material.

COPPER MARKET SITUATION.—Discussing this topic the recent bulletin of the National Conduit & Cable Company said: "The marked feature lately of the copper situation has been the repeated advance in price, and the tendency of values to keep mounting higher and higher. During the past 30 days electrolytic wire bars have advanced from 19¼ to 21½ for future delivery, and conservative people are beginning to wonder where this upward movement is going to terminate. Meanwhile, domestic consumers and foreign buyers have purchased heavily for the forward months, and the total business since August rolls up a tremendous aggregate of sales. Foreign consumers have been specially urgent in getting their requirements filled, and the eagerness of the European contingent to secure copper has gone far in exciting the market to a degree not before witnessed since the days of the Secretan syndicate. American manufacturers were successful in getting a considerable proportion of their orders on the books of producers and selling agents before the market took the bit in its teeth, and many of the big plants are pretty well fixed for some time to come. The slower acting foreign consumers and some belated domestic manufacturers, however, have had to scurry around and pick up whatever they could find at the premiums fixed by those sellers having available copper. There is some difficulty in obtaining full supplies, and it is probable that consumers in this country have not got all the copper they need for the balance of this year. There has been a phenomenal demand for copper during this entire year, and consumption will undoubtedly continue to keep up to a great level if prices do not go so high as to put part of the business hitherto obtained out of reach. We have been firm believers for a long time in the healthy state of trade existing, and that recent strong conditions were fully warranted, but at the same time we adhere to the opinion that prices of raw material should approximate the level of normal values if business is to be kept permanently sound. It may be that present prices of copper are justified, and no doubt they are, while stringent conditions last, but it will not do to twist up prices too high. We think some of the producers have favored a conservative market, and it will be well if they exercise their influence to keep the situation within sane limits. Manufacturers continue very busy, and the outlook is good for an active fall and winter. Sales of copper for near delivery have been made at 22 cents, and in certain instances at higher prices, according as sellers have insisted on securing extra premiums for the limited quantities offered. It is a remarkable situation, and a time for the exercise of wise conservatism. With the high prices now prevalent there is need for more than ordinary caution, and the trade should be careful not to carry surplus stock."

WESTINGHOUSE MANAGERS' MEETING.—The annual convention of the sales managers of the Westinghouse Electric & Manufacturing Company was held at the East Pittsburg works during the week ending October 27. The meetings were conducted by Mr. E. M. Herr, first vice-president, and Mr. L. A. Osborne, second vice-president, assisted by Mr. C. S. Cook, manager of the railway and lighting department; Mr. S. L. Nicholson, manager of the industrial and power department; Mr. C. B. Humphrey, manager of the detail and supply department, and Mr. Walter Cary, general manager of the Sawyer-Man Electric Company. On Wednesday evening, October 24, the officials of the company gave a banquet to the visiting managers at Hotel Schenley, at which there were present, in addition to the officials and managers of the Electric Company, prominent officials of associated interests, including Col. H. G. Prout, vice-president of the Union Switch & Signal Company; Mr. John F. Miller, fourth vice-president of the Westinghouse Air Brake Company, and Mr. E. H. Sniffin, third vice-president of the Westinghouse Machine Company. These annual meetings of the Westinghouse Company were inaugurated a number of years ago, and give an opportunity for the mingling of ideas of the managers from all parts of the country, working under almost every known commercial condition. The convention closed on Saturday last, when the managers returned to their respective territories.

THE PACIFIC NORTHWEST.—It is noted that with more than 900 miles of electric railway lines under construction or projected in the Pacific Northwest, power enterprises in Washington, Oregon and Idaho are keeping apace and large generating plants representing investments of millions of dollars are being installed at various points along the Spokane, Snake, Columbia, Chelan and Kettle rivers. Prominent among the companies already in the field are the Inland Empire Electric Railway Company, the Washington Water Power Company, the Big Bend Water Power Company and the Lewiston Southeastern Company, while several concerns have just been incorporated in Spokane County for development of water power. The Kettle Falls Power Company, which purposes to acquire rights on the Colville River in Washington, has been organized with a capital of $500,000 and these incorporators: H. J. Cole, Charles V. Roberts, J. A. Elliott and D. A. Richardson, of Spokane, and J. M. Reynolds, of Kettle Falls. The company has bought J. W. Reynolds' plant near Kettle Falls and will enlarge it to furnish towns in northern Washington with electric light, to supply the mines with power and, in time, it is expected, may be used for electric railways. A dam has been built across the river near the Columbia.

OSBURN FLEXDUCT.—The National Metal Molding Company, of Pittsburg, announces that having purchased the entire assets, good will, etc., of the Osburn Flexible Conduit Company, it will hereafter control the manufacture and sale of "Flexduct." In order to better serve the interests of the customers, all business pertaining to Flexduct flexible conduit and economy rigid conduit will be conducted from the headquarters of the company,, the Fulton Building, Pittsburg, Pa., where all communications should be addressed on and after November 1, 1906. On and after November 1, 1906, Mr. C. E. Corrigan, vice-president of the National Metal Molding Company, will be located at the general offices of the company, Fulton Building, Pittsburg, Pa.

CHICAGO PNEUMATIC TOOL.—The Chicago Pneumatic Tool Company reports that up to October 25 orders booked had exceeded orders for the first 25 days of October, 1905, 47 per cent and an increase over September of 37 per cent. The amount of business done for the first nine months of the current year has shown an increase of 27 per cent over corresponding periods in 1905. Notwithstanding the fact that the Chicago Pneumatic Tool Company had on its books at the close of the year 1905 in excess of 8,000 customers, it has added to this large list during the first nine months of the current year over 1,500 more customers.

Financial Intelligence.

THE WEEK IN WALL STREET.—The money market was relieved by the action of the Treasury Department, but the unsettled monetary conditions and uncertainty as regards the coming elections rendered the stock market irregular and weak in tone. Scattered liquidation and renewed activity by bears were met with little or no public buying and a withdrawal of manipulative support by pool interests. In point of activity the market was very restricted, interests centering in a few stocks. Steel securities were very heavy in sympathy with the general market.

NEW YORK

	Oct. 23	Oct. 30		Oct. 23	Oct. 30
Allis-Chalmers Co.	17¼	16⅞	General Electric	175¼	173⅛
Allis-Chalmers Co. pfd.	43⅜	44⅛	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	74¾	74½	Mackay Cos.	71	71
American Locomotive pfd.	110	110	Mackay Cos. pfd.	69¾	69
American Tel. & Cable	87	87	Marconi Tel.	...	...
American Tel & Tel.	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	78¾	78½	N. Y. & N. J. Tel.	...	...
Electric Boat	15	16	Western Union Tel.	88½	86¾
Electric Boat pfd.	50	65	Westinghouse com.	150	153
Electric Vehicle	11	12	Westinghouse pfd.	...	...
Electric Vehicle pfd	18	18			

BOSTON

	Oct. 23	Oct. 30		Oct. 23	Oct. 3
American Tel & Tel.	136	135¾	Mass. Elec. Ry. pfd	...	68
Cumberland Telephone	...	...	Mexican Telephone	3⅜	...
Edison Elec. Illum.	235	234½	New England Telephone	130	129¾
General Electric	175½	...	Western Tel. & Tel.	...	9
Mass. Elec. Ry.	9	...	Western Tel. & Tel. pfd.	85	...

PHILADELPHIA

	Oct. 23	Oct. 30		Oct. 23	Oct. 30
American Railways	51½	51½	Phila. Electric	8¼	8¼
Elec. Co. of America	11¾	11¼	Phila. Rapid Trans.	28¼	27¾
Elec. Storage Battery	70	70	Phila. Traction	97¾	97⅝
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Oct. 23	Oct. 30		Oct. 23	Oct. 30
Chicago City Ry.	140	130	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	116	117
Chicago Subway	...	53¾	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	25	25			

Little attention was paid to the railroad and other annual reports, which were given out during the week, although they were in the main of the same highly favorable tenor as those which have heretofore appeared this season. Bonds were steady, but the investment demand was limited by the high rates for money. Electrical securities were rather quiet and no marked changes in prices are noted. Allis-Chalmers, both common and preferred, are slightly advanced, common closing at 17⅛ and preferred at 44¾. General Electric declined 1 point, the last

quotation of the week being 174, while Westinghouse was steady at 154. Among the railway stocks, Brooklyn Rapid Transit, with a very moderate business, closed at 78¾, which is 1⅝ points better than last week's closing price. Inter-Metropolitan common closed at 36⅝ and preferred at 76¼, both of these prices representing fractional gains. American Locomotive common is quoted at 74¼, which is an advance of 2¼ points, and preferred at 111, a net decline of 1 point. The last quotation of the week for Western Union was 86¾, and of American Telephone & Telegraph 137⅛. The curb market showed the same liquidating tendencies that were present on the main exchange. Apart from the activity in some mining stocks there was little business done in the miscellaneous list, and in a general way prices sagged. The public participated very slightly in the market. The closing quotations of October 30 are given in the accompanying table.

CHICAGO SUBWAY DEAL.—According to Mr. J. J. Mitchell, agreement has been reached in the proposed Chicago Edison-Chicago Subway "deal." Instead of the Chicago Subway building its own independent power plant, it is proposed that it shall organize an electric power and light company with $5,000,000 of capital paid in, and take over the Chicago Edison Company on a guarantee of 8 per cent dividends for three years, 8½ per cent for two years and 9 per cent thereafter for the balance of ninety-nine years, with right to purchase the Edison Company's $13,000,000 capital stock at about $175. Calls will be issued for the deposit of Chicago Edison shares under this agreement. New financial plans are under way for Chicago Subway, and as a preliminary $2,500,000 has been paid into the treasury of the Chicago Subway, which it now has in cash on hand, making its indebtedness due next December $5,500,000, which will be taken care of in the new financing. There will be enough bonds to retire the present outstanding Chicago Subway bonds, to pay the obligations maturing next December, and to provide the $5,000,000 for the extension of the Chicago Edison Company demanded in the contract of that company without increasing the obligations of the Chicago Edison. The shares of the Chicago Subway will, in due course, be prepared for listing on the New York Stock Exchange. The $10,000,000 required by the independent telephone interests has been underwritten, and $3,000,000 of this has been paid into the Chicago Subway telephone department, which will also receive a minimum rental of $5 per annum per telephone on 20,000 telephones. It is intimated that Mr. E. H. Harriman and the Illinois Central Railroad are interested. (Later)—It is stated by the Chicago newspapers that the Chicago-Edison Subway deal has been closed, taking in the $13,614,440 of Chicago Edison stock on a basis of $200 a share. In order to finance the purchase of the Edison Company it is proposed to organize the Chicago Electric Power & Light Company, with a capital ranging from $5,000,000 to $15,000,000 paid in to take over the Edison plant on a guarantee of 8 per cent dividend for three years, 8½ per cent for two years, and 9 per cent for the balance of the term of ninety-nine years, with the right to purchase the Edison Company's issue of $13,614,440 at $200 a share. Calls will be issued at once for the deposit of Chicago Edison shares under the agreement. The $10,000,000 required by the Independent Telephone Company to finance its operations in Chicago has been underwritten by Kuhn, Loeb & Company, and $3,000,000 of the purchase price to the automatic telephone service is to be paid over to the Chicago Subway Company. In addition, it is understood that the Subway's telephone department will receive a minimum rental of $5 annually each of the 20,000 telephones in the circuit, which will be added to the company's income. The business of the Subway Company has steadily increased since the tunnels were opened to the reception of merchandise a few months ago, and its financial backers are satisfied with the income derived so far from the traffic handled. The earnings of the Chicago Edison Company have steadily increased for several years, the net income for the fiscal year ended March 31 being $1,550,000 on a gross business of $4,750,000.

WEST PENN CONSOLIDATION.—Last week some 30 electric lighting companies, scattered in small cities through Allegheny, Washington, Westmoreland and Fayette counties, Pennsylvania, were absorbed into the West Penn Electric Company, an affiliated concern with the West Penn Railways Company. The parent company is controlled for the most part by Pittsburg capital. The combination which backed the Pittsburg, McKeesport & Connellsville Railway Company, now controlled by the West Penn Railways Company, has been perfecting the merger for over two years. The projectors of the West Penn Electric Company started out three years ago to control the public lighting plants of the cities and towns in the coke region. The company was formed in December, 1904, at which time it controlled the most valuable charters of that region. Then an effort was made to absorb the local companies in the smaller cities and towns along the Monongahela valley. Control has been gained of these, one by one, during the past two years. Now the Pittsburg interests are ready to merge them. This done, and the territory occupied almost exclusively by the West Penn interests will extend north and south and east and west for nearly 50 miles. The original consolidation, when the West Penn Electric Company was organized in 1904, with a nominal capital of $337,500, included subsidiary companies in the following cities and towns: Dawson, Uniontown, Connellsville, Bullskin, Dunbar, Fairchance, Masontown, West Fayette, Huntingdon, East Huntingdon and Hempfield. The organization was effected with the following officers, all of Pittsburg: President, William S. Kuhn; vice-president, James S. Kuhn; secretary, R. P. Watt; treasurer, J. von Wagoner; purchasing agent, H. F. Barnard; superintendent, W. E. Moore. The operating office is at Connellsville. The small concerns, the control of which has since been secured, and which will be voted into the present company at meetings to be held during the latter part of October, are located at the following points: Charleroi, Brownsville, Monongahela City, Smithfield, New Haven, Greensburg, Vanderbilt, Everson, Youngwood, Youngstown, Bellevernon, Carroll, Fallowfield, Fayette City, California, Coal Center, Stockdale, Rostraver, Speers, West Pike Run, Twilight, Monessen, North Charleroi, Allen and Elco. It is obvious that marked economies must result from the operation of these plants from one or two central points.

WESTERN TELEPHONE STOCK.—It is noted from Boston that the preferred stock of the Western Telephone Company is now selling at about 85 and the common at 10, against a high last January of 98½ for the preferred and 17½ for the common. There is $16,000,000 of each issue outstanding. The decline and the present heaviness of the stock are due to a variety of causes, the principal one being the general understanding that new financing would shortly be necessary. The last annual report of the company for the year ended January 31, 1906, contained a statement by President Fish that the directors had under consideration a plan to take care of the company's floating debt, amounting to over $4,000,000. As a matter of fact, no new financing will be made for several months at least. The directors have had in mind for almost a year an issue of bonds, sufficient to clear up the floating debt and provide for future requirements. The announcement of this plan has been delayed by the stagnant condition of the bond market. There are other causes, however, contributing to the narrow and heavy market for Western Telephone stock. In the first place, the two-year exemption period on the preferred stock expired in February, 1904, and as only 5 per cent yearly has been paid on the preferred for the past two years, there are cumulative dividends hanging over the stock of 2 per cent. Furthermore, three of its four constituent companies have this year authorized increases in their capital stock amounting to an aggregate of $27,000,000, and one company, the Wisconsin Telephone Company, offered to its stockholders on July 31, $4,516,600 of new stock, over 75 per cent of which the Western Telephone Company will have to take in order to maintain its present ratio of stock control.

COLORADO POWER.—The Central Colorado Power Company is in process of organization under the laws of Colorado, for the purpose of acquiring and developing water power properties on the Grand River in Central Colorado. The company will have a total authorized capitalization, including bonds and stocks, of $42,500,000, made up as follows: Forty-year 5 per cent bonds, $20,000,000; preferred stock, 6 per cent; cumulative after January 1, 1910, $7,500,000; common stock, $15,000,000. Total, $42,500,000. It is proposed to develop ultimately 80,000 hp from which 100,000 hp can be sold. However, in the first instance, 30,000 continuous hp will be developed, and for this purpose arrangements are being made to sell $9,000,000 of the bonds. Besides the bonds $4,500,000 of the preferred stock and $15,000,000, or all, of the common stock will be issued now. The preferred stock is redeemable at 120 after July 1, 1912.

DIVIDENDS.—The Cambridge (Mass.) Electric Light Company has declared a regular quarterly of 2½ per cent, payable November 1, to stock of record, October 20. The Tampa Electric Company has declared a semi-annual dividend of $5 per share, payable November 15, to stock of record, November 1. The directors of the Consolidated Gas Company of New York have declared the regular dividend of 1 per cent, payable December 15. The directors of the New England Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable November 15.

GENERAL NEWS.

Construction News.

ENSLEY, ALA.—The Southern Bell Telephone Company is constructing a new exchange in this city. The service at Pratt City, Wylam, Fairview and the surrounding territory will be operated from this exchange.

ALAMEDA, CAL.—At a meeting of the Council, held Oct. 15, the city electrician was instructed to place additional oil storage tanks at the municipal light plant.

OROVILLE, CAL.—The Western Power Company, which is interested in the Reno power and water enterprise, is engaged in the development of a large plant upon the sources of the Feather River, near Oroville. The agents of the company have acquired a large acreage of land, and it is reported that within the next three years they will invest $5,500,000 in this locality.

PASADENA, CAL.—The contract between the city of Pasadena and the Edison Electric Company under which the corporation is to furnish electricity for the street lamps until the completion of the municipal lighting plant has been signed by all parties.

LOS ANGELES, CAL.—Contracts have been closed between the Desert Power & Water Company and the Gold Road Mining & Exploration Company for an electric power plant having a capacity of 2,200 hp, to be erected at Kingman, Ariz. Work will begin on the plant in about 30 days. Oil will be used for fuel.

LOS ANGELES, CAL.—Unable to furnish a third dredger in less time than sixty days, the North American Dredging Company has notified the Los Angeles Dock & Terminal Company that in order to fulfill its contract on the inner channels it will substitute electricity for steam on the suction dredger as soon as poles and wires can be placed and the capacity of the machine doubled.

FULLERTON, CAL.—The Home Telephone Company has completed its main line between Fullerton and Anaheim and will now begin work on the Fullerton exchange. Eight car loads of poles have been received at Anaheim and seven at Fullerton, to be used in building the northern Orange County system. Work will soon begin on the extensions to Placentia, Olinda, La Habra, and Buena Park, which will be completed in six months at an expense of about $40,000.

LOS ANGELES, CAL.—The Union Home Telephone & Telegraph Company, of which Col. John M. C. Marble is president, and James V. Baldwin secretary, has filed its certificate of the creation of a bonded indebtedness with the county clerk. The capital stock of the company is $10,000,000, and the bonded indebtedness $10,000,000. This action marks the completion of the great organization which has acquired most of the independent Home Telephone Companies in Southern California.

GREELEY, COL.—Paul E Darrow, 522 First National Bank Building, Chicago, Ill, will have charge of the work contemplated by the Greeley Gas & Electric Company. The probable cost of the work is placed at $25,000. No bids will be called for.

HARTFORD, CONN.—The Consolidated Railway Company has completed preliminary arrangements for the construction of the proposed electric railway from Thomaston to Waterbury and some of the contracts have been awarded. The company has also commenced the construction of an interurban electric road between Middletown and Meriden.

DERBY, CONN.—The Derby Gas Company is making extensive improvements in its electric department, which will more than double the capacity of the plant. The system is being changed from direct to alternating current. A Curtis steam turbine of 500 kw is now being installed. The two direct-current machines will be supplanted by a 450-kw alternating-current generator. The company supplies both gas and electricity in Ansonia, Derby and Shelton.

NEW HAVEN, CONN.—It is reported that the recent purchase of the valuable water rights of the electric power plant at Fall Village is in the interest of the New York, New Haven & Hartford Railroad Company, and that the company will erect a power house there to furnish electricity for its railway lines which it is extending down the Berkshire Valley to Canaan, Conn., a few miles away. The plant, which is one of the most important of the kind on the Housatonic River, has just been purchased from the Falls Village Water Power Company by the Connecticut Power Company of this city. The projectors of the Connecticut Water Power Company refuse to state what they will do with the newly acquired power plant. The Connecticut Railway & Lighting Company has an electric power plant at Bull's Bridge dam, about 20 miles below Falls Village, and will soon erect another dam across the Housatonic River at Boardman's Bridge, a few miles below Bull's Bridge, at a cost of $700,000.

SMYRNA, DEL.—At a special meeting of the Town Council, held Oct. 25, it was decided to purchase a new boiler of 150 hp for the municipal electric light. The water and light committee was authorized to ask for bids and to report to the Council at a meeting to be held Nov. 2.

WILMINGTON, DEL.—The new plant of the Wilmington Light, Power & Telephone Company was formally opened Oct. 25. The plant has a capacity of 2,000 kw and cost $600,000. The company also controls an automatic telephone system, which connects with the Maryland Telephone Company. George R. Webb is vice-president of the company.

WASHINGTON, D. C.—The Potomac Electric Power Company will soon install rotary and static transformers in its new building, at an estimated cost of $25,000. Fissell & Wagner are the contractors.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., until Nov. 20, to furnish at the navy yards, etc., Portsmouth, N. H., Boston, Mass., New York, N. Y., League Island, Pa., Annapolis, Md., Washington, D. C., Norfolk, Va., and Charleston, S. C., a quantity of naval supplies as follows: Schedule 230—Tile conduit, incandescent and arc lamps, arc lamp globes and carbons, etc., battery, waterproof telephone and rubber-covered wire, telephone cable, wire switches, transformers, fuses, vulcanized fiber rod, steel and wood cross arms, insulators, electrical supplies, etc., sheet copper, pipe and fittings, separator, installing boiler piping, grading etc. Schedule 231—Desk fans, switches, annunciators. Schedule 232—Portland cement, conduit, telephone cable, electrical supplies, copper netting, etc. Schedule 233—Crane trolley, hydraulic jacks, sheet copper, etc. Schedule 235—Electrical supplies, rolled brass and copper, Muntz metal, etc. Schedule 236—Pumps, hydraulic leather, rolled copper and brass, etc. Application for proposals should designate the schedules desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

COLUMBUS, GA.—The Eagle and Phenix mills are installing an auxiliary electric power plant at a cost of about $15,000.

BOISE, IDAHO.—The Western Power Company, of Boise, Idaho, which is controlled by Western capitalists, has retained Arthur Giesler, 29 Broadway, New York, N. Y., to take charge of supervision and engineering work in connection with its new 20,000-hp hydro-electric plant, to be erected on Payette River, near Oxbow, Idaho. The power will be developed by 4 units of 4,000 hp capacity each, operating under a 150-foot head. The power, most of which has been contracted for, will be used in mining, street railway work and for lighting and miscellaneous work in various towns in the vicinity. Surveys are at present being made, and it is estimated that the development will involve an expenditure of $1,500,000.

CHANNAHON, ILL.—Plans have been prepared by D. W. Mead for the construction of a heat, light and power plant in this place for the Channahon Power Company, of Chicago. The plant will cost $100,000.

CULLOM, ILL.—Havens & Heckelman, of Cullom, are the promoters of the new electric light plant, to be constructed here. The electricity will be brought from another plant, 10 miles distant. Harry Havens is the engineer.

FREEPORT, ILL.—Two new boilers have been placed in the municipal water and light station and will be put in operation within ten days. The boilers have a combined capacity of 300 hp and will be placed in the new plant, which will be built next spring.

TAYLORVILLE, ILL.—An ordinance has been signed by Mayor Leigh granting to the Springfield & Southeastern Traction Company a fifty-year franchise to operate its line on the streets at Taylorville. The company has the entire right of way for its proposed route from Pana to Springfield.

CHICAGO, ILL.—The Schriver Laundry Company has recently installed alternating-current motors to operate the laundry machinery. The motors were furnisned by the Stanley-G. I. Electric Manufacturing Company, of Pittsfield, Mass. Electricity for light and power is generated on the premises.

CHICAGO, ILL.—The Manufacturers Telephone Company, represented by Attorney Levy Mayer, has appeared before the Council Chamber on Gas, Oil and Electric Light as an applicant for a telephone franchise in Chicago. Another applicant is Arnold Kalman, of Kansas City, formerly vice-president of the Chicago Great Western Railway, who is interested in the Independent Telephone Company in Kansas City.

RUSHVILLE, IND.—The City Council has let the contract to the Fort Wayne Electric Company for enlarging the electric light plant at a cost of $6,500.

FORT WAYNE, IND.—The Toledo & Indiana Railway Company has completed arrangements for the extension of its line from Bryan across northern Indiana to Fort Wayne by the way of Waterloo.

LA PORTE, IND.—A fifty-year franchise has been granted to the Chicago-New York Electric Air Line Railroad. The franchise will be used by that railroad for the entrance into and terminal in La Porte for its spur track from the main line, which passes about 3½ miles south of this city.

GOSHEN, IND.—The promoters of the Plymouth, Goshen & White Pigeon Railway Company have announced that the proposed road has been financed and that construction will begin in a short time. The road which will be 60 miles in length has been surveyed. The power house is to be located in this city.

TERRE HAUTE, IND.—The Columbian Improvement Company, which has been engaged in engineering and construction work in and about Terre Haute for the Terre Haute Traction & Light Company, has been reorganized as the Stone & Webster Engineering Corporation of Boston. Russell Robb is president.

NEW CASTLE, IND.—The Allis-Chalmers Company, of Milwaukee, Wis., which has the contract for the construction of the Indianapolis, New Castle & Toledo traction lines is receiving bids and preparing to sublet

the contract for the construction of the large power plant near this city. The foundation for the power house has been completed.

INDIANAPOLIS, IND.—The steam and interurban railway companies entering this city have decided to fight the enforcement of the ordinance recently passed by the City Council to require them to maintain arc lamps at all grade crossings. The members of the Board of Public Works are threatening to assess the penalty for violation of the ordinance on all the roads refusing to pay for light after Nov. 1. The penalty is $100 a day for each day, and on each lamp.

INDIANAPOLIS, IND.—The contract for the steel construction work of the new Central Union Telephone building, to be erected on the corner of Meridian and New York streets, has been let to the Brown-Ketcham Iron Works. The company has almost completed its conduit system, and is constructing new cable on pole lines in all parts of the city, and other portions of the state. The company has recently purchased two lots on Main street, in the town of Beech Grove, which is being established 7 miles south of Indianapolis, on which it will erect a modern telephone exchange building.

RICHMOND, IND.—Ground has been broken for the construction of the Home Telephone Company's exchange building, which is to be equipped with a new $100,000 Automatic Telephone system. The City Council and the Bell Telephone Company are having trouble because of an ordinance recently passed requiring that all telephones, telegraph and light companies must put their wires underground in the business section of the city. The Bell company is reconstructing its overhead system. The telephone company claims that the charter provides for an overhead system and will resist the attempt of the Council to force its wires underground.

CHICKASHA, I. T.—The Chickasha Gas Company has petitioned Council for an electric light franchise.

GUTTENBERG, IA.—The Guttenberg electric light and power plant, which was owned by Z. C. Houck, has been purchased by W. S. Horry, of Niagara Falls, N. Y. The plant will be enlarged and new machinery installed.

ESSEX, IA.—The citizens have granted Oscar Nelson a franchise to operate an electric lighting system in Essex for 20 years. He will not construct a plant, but will procure the electricity from Shenandoah. He will put up wires at once.

LOUISVILLE, KY.—The question of new arc lamps for the city is now being considered by the Board of Public Works.

FALMOUTH, KY.—W. E. Wilson, city clerk, writes that bids will be received on Nov. 12 for a franchise for an electric light plant.

LOUISVILLE, KY.—Plans for the construction of 46 miles of track from Beechwood Station, three and one-half miles east of the city limits, to Frankfort, by the way of Shelbyville, are on file in the office of the Louisville & Eastern Railroad Company, and bids for the construction are being asked. Percival Moore, vice-president of the road, states that work on the extension of the road will commence as soon as the contract is awarded.

AUGUSTA, ME.—The Cleveland Electric Company, of Portland, is installing electric cranes in the plant of the Tayntor Granite Company in this city.

DEXTER, ME.—The citizens of this town are now agitating the question of an all-night electric light service, and a petition is being circulated asking the Dexter Electric Light Company to make the desired change.

BAR HARBOR, ME.—Beginning with Nov. 1 the Bar Harbor & Union River Power Company will give five per cent discount on monthly lighting and power meter bills paid on or before the 10th of the succeeding month, while discounts will be made for large quantities consumed as in the past. The company will also furnish free lamp renewals after Nov. 1.

EASTPORT, ME.—Several carloads of poles have been received here for the Pembroke Light & Power Company, and the work of erecting them has started. The new company will have its plant at Pembroke and transmission line to Eastport completed early in 1907. The company will furnish electricity to the Eastport Electric Light Company.

BANGOR, ME.—The power plant of the Bangor & Aroostock Railroad at Stockton Springs has been completed. The power house is situated at Kidder's Point, and is equipped with a high-speed Fleming engine, direct connected to General Electric alternating-current generator and exciter having a capacity of 150 kw. A 45-hp induction motor direct connected to a 30-kw direct-current generator has been installed to operate the various carrying devices for handling the products in the storehouses The plant will furnish electricity for lighting the depot, freight sheds and wharfs at Kidder's Point and Cape Jellison.

CENTERVILLE, MD.—The Town Commissioners have granted W. J. Peall, of Wilmington, Del., a franchise for an electric light, heat and power plant.

EASTON, MD.—Williams, Proctor & Potts, Inc., of New York, N. Y., have been selected to prepare plans for a sewerage system and sewage disposal plant, water works, electric light plant, and drainage system, at Easton.

FREDERICK, MD.—J. W. Le Gore is contemplating the erection of an electric plant near Frederick and is promoting an electric railway project under the name of the Washington, Le Gore & Gettysburg Railway Company. The plan is to build a line between Washington and Gettysburg, to be operated by electricity from the Le Gore plant. A franchise has been secured from the Westminster Council for the use of the streets in that place.

NEW BEDFORD, MASS.—Important changes, including an increase of capital stock and the replacement of the present equipment with new, have been decided on by the Automatic Telephone Company of this city.

ATTLEBORO, MASS.—The Selectmen have granted a franchise to the Interstate Consolidated Company, to build a loop line from Attleboro Centre to the new station. The company will also build a new line to South Attleboro.

STOCKBRIDGE, MASS.—At a meeting held Oct. 22 it was practically decided to form an electric lighting company with a capital stock of $25,000. Electricity will be obtained from the Berkshire Street Railway Company and the wires will be laid in conduits in the main streets of the town.

NORTH ATTLEBORO, MASS.—The Selectmen have issued a call for a special town meeting to be held Nov. 6, for the purpose of voting on the application of the Electric Light Commissioners for an increase of $6,000 in the appropriation made for improving the electric light plant, so as to provide for day service.

PEABODY, MASS.—The report of the Electrical Auditing Company, of Boston, on the Peabody municipal electric light plant, recommends that the town secure service from the Salem Electric Light Company; a development of the sale of electrical energy for power purposes, and a change of business methods, and also recommends the sale of a lot of old machinery and equipment.

LAWRENCE, MASS.—The County Commissioners will receive bids for installing an electric lighting system in the old building at the county training school at Lawrence. The commission will soon take up the matter of rearranging the lighting system in the court house in Salem, and will probably install an electric plant to light the court house, jail, house of correction, and the new registry of deeds.

MANSFIELD, MASS.—It is reported that plans are nearly completed for the construction of a large electric light plant here for the New York, New Haven & Hartford Railroad Company. The plant will provide electricity for the yards, freight house and station, and it is also said that it may furnish electricity for the extension of the lighting system to Taunton and other stations in this vicinity.

WOBURN, MASS.—An extension of the power service furnished by the Edison Electric Illuminating Company has been made, which will be of importance to the company's customers in Woburn, Winchester and Stoneham. Heretofore the power service has been operated only between 7 o'clock in the morning and 6 at night, but has been available at other times on request. Now the regular service will be operated from 6 in the morning until 10 at night.

SOUTH HAVEN, MICH.—The Board of Public Works is contemplating the extension and repairing of the electric light plant at a cost of $17,000.

CLARKSON, MICH.—The organization of a company for the purpose of installing a water works system and an electric light plant is under consideration in this place.

CADILLAC, MICH.—D. J. Albertson, of Kalamazoo, is engineer for the proposed dam in Marintee River, at Cadillac, contemplated by the Electric Land & Development Company, of Traverse City.

PAW PAW, MICH.—All bids opened on Oct. 8 by the Village Council for the construction of a dam here have been rejected, being too high; the Illinois Bridge Company bid for the construction of dam and installation of all machinery with direct connection $46,400, and George Rickman Sons, of Kalamazoo, bid for construction alone $33,379.

MARQUETTE, MICH.—At a forced sale of the Marquette County Gas Light & Traction Company at Ishpeming, Oct. 23, the property was purchased by Granger Farwell, of Chicago, Ill., holder of the bonds, for $289,000. The company's holdings include a gas and electric light system and a street railway, all three serving the cities of Ishpeming and Negaunee.

SAULT STE. MARIE, MICH.—President Charles B. Warren, of the Lake Superior corporation, has announced that plans for improvements to the Michigan power plant, to cost $500,000, are now in the hands of contractors, and that the contract for the work will be let soon. It will take five months to complete the work, which will greatly increase the efficiency of the plant.

GRAND LEDGE, MICH.—The Commonwealth Power Company is constructing its transmission line from Lansing to the new dam, 20 miles below Grand Ledge. When completed the towers will carry three lines, which will transmit the entire electrical power of the Lyons dam, which is estimated at 5,000 hp. It is understood that the company will furnish electricity in Portland and Grand Ledge, and later on to the farmers for light and power.

MINNEAPOLIS, MINN.—Bids will be received by the City Council until Nov. 22 for lighting the streets during 1907.

HIBBING, MINN.—The village has purchased a dynamo and engine for the municipal electric light plant from the Burgess Electric Company, of Duluth, for $7,309.

LE SUEUR, MINN.—The Electric Machinery Company, of Minneapolis, has been awarded the contract for installing the new generator in the municipal electric light plant.

WIGGINS, MISS.—F. D. Smith, of Indianapolis, Ind., has decided to construct an electric light and power plant, also an ice plant at Wiggins.

BEATTY, NEV.—The New York Electric Power & Reduction Company, of New York, N. Y., has purchased water rights from A. L. Lidwell, about 20 miles from Beatty, and will build a large mill and reduction works. a brewery and an electric plant. Thos. L. Rankin, Sacket Harbor, N. Y., and M. Newton, of Wilmington, Vt., are interested.

CONCORD, N. H.—The White River Ice & Coal Company has purchased the plant and holdings of Clarendon Electric Light & Ice Company.

BERLIN, N. H.—The Berlin Mills Company has purchased the entire plant of the Berlin Electric Light Company, and has taken possession of the plant.

CHARLESTON, N. H.—Geo. D. Nourse, chairman Electric Light Committee, writes that it is proposed to form a local company under the supervision of the local Board of Trade, to construct an electric light plant. No engineering work has been done as yet. The matter is merely being discussed.

PORTSMOUTH, N. H.—The American Shore Line Railway, which is building a line from York Beach to Kennebuck, Me., a distance of 18 miles, to complete connections between lines following the coast from Portsmouth to Portland, expects to have its line laid out and graded by December 1.

LACONIA, N. H.—The controlling interest in the Laconia Electric Lighting Company has been purchased by H. L. Pierce, president of the Laconia Street Railway Company. The Laconia Electric Lighting Company practically controls the lighting and electric power service in this city and the adjoining town of Meredith. Two years ago the company secured a 10-year contract from the city of Laconia for street lighting, and also furnishes electricity for operating the Laconia Street Railway and many manufacturing plants in the city and in Lakeport, where the power plant is located. It is stated that another attempt will be made the coming winter to secure from the incoming Legislature a charter for the Winnipiseogee Valley Electric Railway, which is designed to be an extension of the Laconia road, and to make connection with the Concord & Montreal electric branch of the Boston & Maine at Penacock, running through East Tilton, Tilton, Franklin and Boscawen.

ATLANTIC CITY, N. J.—The City Council has awarded the contract for illuminating the boardwalks with 10,000 incandescent lamps during the winter and spring season to the Atlantic City Electric Light & Power Company.

SODUS, N. Y.—Work has commenced on the system of street lamps which will be installed in this village by the Sodus Gas & Electric Company. An all-night service will be given.

MIDDLEVILLE, N. Y.—The State Gas Commission has granted the Middleville Electric Light Company permission to increase the amount of its capital stock from $4,000 to $12,000.

MONROE, N. Y.—This village has contracted with the Heat, Light & Power Company, of Despatch, for lighting the streets of the village with electricity, at a cost of $1,170 a year.

OSSINING, N. Y.—The Board of Trustees has decided to grant a franchise to the Hudson River & Eastern Traction Company. Francis A. Stratton is president of the traction company.

FULTON, N. Y.—At a meeting of the directors of the Oswego County Independent Telephone Company held recently for the purpose of organization, H. Lester Paddock was elected president. The company is planning to build a three-story building on First street.

ALBANY, N. Y.—The Rochester, Scottsville & Caledonia Electric Railroad Company, of Monroe County, has received authority from the State Board of Railroad Commissioners to construct its proposed road. The Carthage & Copenhagen Railroad Company has been granted permission by the commission to issue a $60,000 mortgage.

FAYETTEVILLE, N. C.—The Fayetteville Street Railway & Power Company has commenced work on the construction of its proposed line. S. H. Macrae, J. H. Anderson, W. E. Kindley and W. B. McNeill are interested in the project.

CHARLOTTE, N. C.—The Southern Power Company has filed an amended certificate with the Secretary of State in New Jersey, increasing its capital stock from $7,500,000 to $10,000,000. The company is now furnishing electricity for street lighting in the town of Clover, S. C., and has recently closed a contract with the Cannon Cotton Mills, of Concord, N. C., for 5,000 hp for operating the mills; a contract has also been made with the Odell mills in the same town for 1,800 hp, and it is expected that an additional 1,000 hp will be placed for smaller plants by the end of the year.

HICKORY, N. C.—A syndicate of Pennsylvania capitalists has purchased the plant and holdings of the Thornton Light & Power Company, which include the Thornton Shoals and lands on the Catawba River, three miles north of the city, and also the Odell holdings of the Horseford Shoals. The dam and power house will be erected 2½ miles below the Odell Shoals, which will cost about $1,000,000 and have a capacity of from 10,000 to 12,500 hp. The company will furnish electricity to Hickory, Newton, Morganton, Maiden, Lenoir, Hudson and Granite Falls. Marcellus E. Thornton, president of the Thornton Light & Power Company, writes that he will now proceed with the proposed electric street and interurban railway system as the hydro-electric plant is now assured.

FARGO, N. D.—The North Dakota Independent Telephone Company has petitioned for a franchise for permission to erect and maintain a long-distance telephone exchange within the city limits.

TOLEDO, OHIO.—The Erie Railroad Company will soon commence the construction of a large electric power plant at its ore docks in Cleveland to operate its extensive ore unloading machinery.

MOUNT STERLING, OHIO.—Work has commenced on the rebuilding of the municipal electric light plant, which will cost $10,000. The work is being done by the Columbus Equipment Company.

CLEVELAND, OHIO.—Bids will be received until Nov. 7 by the Board of Public Service for furnishing material and erecting complete, steam, exhaust and water piping for the municipal electric light plant. A. R. Callow is secretary.

CINCINNATI, OHIO.—President Norman G. Kenan, of the Union Gas & Electric Company has announced that the company will soon install a 7,000-hp turbo-generator set at its Plum street station. The company is contemplating greatly increasing its lighting and power system.

AKRON, OHIO.—Thomas L. Childs, promoter of the proposed Akron & Youngstown Electric Railway, claims that all necessary right of way for the proposed line has been secured and that arrangements have been completed with Chicago financiers to finance the road. The preliminary engineering work is now being done.

DAYTON, OHIO.—The Dayton Lighting Company has received its first shipment of cable for its conduit system, which is being installed here. Over 500,000 feet of cable has been ordered by the company. The laying of the conduits is now being rapidly pushed to completion, and it is expected to have the entire system completed within the next month, and the greater part of the cable will be placed by the first of the year.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company is erecting a new sub-station near Dover to take care of the load between Rocky River and Avon Beach power station, which has heretofore been supplied by two direct-current machines in the power station. When the new turbine now being installed at Beach Park is completed, these will be used for auxiliary equipment. The new sub-station is being equipped with two 400-kw Westinghouse rotaries.

GALION, OHIO.—W. E. Moser, of Toledo, representing capitalists who proposed to build the Marion & Bucyrus Electric Railway, is endeavoring to interest the various towns along the route in a plan to build the lines from Marion to Galion instead of to Bucyrus. Galion people are asked to subscribe to $25,000 worth of bonds, to be paid for when the road is completed. If this plan is carried out, the company will secure electricity from the new plant of the Crawford County Gas & Electric Company, at Galion.

FALLS CITY, ORE.—The Council has granted the Northwestern Guarantee & Trust Company a franchise to erect and maintain an electric power plant here.

PORTLAND, ORE.—The Portland Railway Company is considering the extension of its Woodstock branch. F. L. Kneeland, president of the Mount Scott Improvement Association, states that the proposition is to extend the Woodstock line from its present terminus along Woodstock avenue to Maria street.

ALBANY, ORE.—Walter Mackay has filed with the County Recorder two notices of location of water rights in Linn and Marion counties, aggregating 42,000 hp, for the purpose of generating electric energy for use in the Willamette Valley for the operation of electric railroads and electric light plants. A large reservoir will be built at Marion Lake, just across the line in Marion county and near the summit of the Cascade Mountains.

ALBANY, ORE.—S. W. Curtis, representing California capitalists, has filed notices of location of water rights on Clear Lake and the headwaters of its outlet, the McKenzie River, appropriating 40,000 miners' inches of water. He expects to make Clear Lake a reservoir and build a dam 50 feet high at the outlet; a canal will then be constructed 6 miles long, 25 feet in width and 8 feet deep. The water will be discharged in the McKenzie River, a mile above the mouth of Smith River, which will be the site of the proposed power plant.

ERIE, PA.—The Mutual Telephone Company, of Erie, has increased its capital stock from $150,000 to $200,000.

DALLASTOWN, PA.—The Edison Electric Light Company, of York, has decided to petition for a franchise in Dallastown.

NEWPORT, PA.—Frank M. Waring, of Tyrone, is interested in the construction of an electric power plant and sanatorium, and has purchased the property of the Iroquois Club House in Perry County for a New York Syndicate, which proposes constructing a dam in Juniata River and developing the water power for electrical purposes.

YORK, PA.—The York & Windsor Electric Light Company has changed hands and is now controlled by York capital. The controlling interest has been purchased by Michael Hose, of Dallastown; Horace Welty, of Red Lion; George A. Kohler, of Yoe, and George S. Billmeyer, of York, who will form the board of directors of the new company.

PHILADELPHIA, PA.—The question of competition in electric lighting has again been brought before the City Councils. Both of the ordinances for the granting of a franchise to one of the two companies—the Commonwealth and the Citizens—were referred by the City Councils' electrical committee to a sub-committee of five, without limitation of time as to rendering the report. The proposition of both companies are similar, each agreeing to accept a franchise to compete with the Philadelphia Electric Company for a limited period of years only in the Commonwealth's case for 50 years and in the Citizens' Company case for 30 years. In addition both companies propose to give the city a share of their profits and to light the city streets for considerably less than is charged by the Philadelphia Electric Company. The Committee of Seventy, which at first favored the acceptance of the Citizens' Company ordinance, now withdraw any recommendation, leaving the question of the acceptance or rejection of either to the Councils entirely.

HUNTINGDON, PA.—The first hydro-electric plant of the Juniata Water & Power Company and the Juniata Hydro-Electric Company, in Warriors Ridge Gap, near Huntingdon, is nearly completed. In this plant will be installed five hydraulic turbines of about 1,000 hp each, direct connected to 500-kw generators. Work on the second plant in the same gap will soon be started. This plant will have a capacity of 4,000 hp. An auxiliary steam plant is being constructed in connection with these plants in which will be installed four steam turbines with a total capacity of over 4,000 hp. Distributing stations will be erected at

Altoona, Tyrone, Huntingdon and other points requiring electricity, extending as far east as Lewiston. In addition to the two plants above Huntingdon, the company has purchased several thousand acres of land along the Raystown branch of the Juniata River and along the main stream below Huntingdon for the purpose of constructing several additional plants, all of which will feed into the same general transmission system. With the plants now being constructed and those for which plans are being prepared the company's plants will have a capacity of about 20,000 hp.

SENECA, S. C.—W. F. Austin, Mayor, writes that an election will be held, to vote on issuing bonds for water works and an electric light plant.

UNION, S. C.—The city has contracted with the Stanley-G. I. Electric Manufacturing Company for equipment for the municipal electric lighting plant. The plant will cost about $11,000.

CHARLESTON, S. C.—Specifications for the power and line equipment of the Charleston & Summerville Electric Railway have been completed by D. E. Baxter & Company, for which they have the construction and equipment contract. The power house will be located about nine miles from Charleston. The equipment will consist of two Snow gas engines having a capacity of 800 hp, and two single-phase 25-cycle generators of 600-kw capacity.

PALESTINE, TEX.—The Palestine Electric Company has closed a deal for the property known as the Howard Oil Company property, and will build its new electric light plant on the site.

HUBBARD CITY, TEX.—The Union Central Light & Ice Company has filed an amendment to its charter, increasing the capital stock of the company from $35,000 to $50,000. W. A. Bass is president and manager.

BROWNSVILLE, TEX.—Owen Ford, of St. Louis, Mo., has offered to finance and install in this city water works and an electric light plant provided the citizens subscribe $25,000. The offer has been accepted.

GALVESTON, TEX.—Surveys are being made on the third line from Houston to Galveston for Stone & Webster, of Boston, Mass., starting at Crystal Springs on the Telephone road. Three sites for the power plants are being considered, but no decision has been reached as to the location, as that depends upon the route decided upon.

PROVO, UTAH.—The Telluride Power Company has applied to the State Engineer for 600 feet of water for power and irrigation purposes, to be pumped from Utah Lake. The pumping station will be located in the lake and water conveyed and emptied into Jordan River and taken out in a flume near Jordan Narrows power plant, and used for generating power. It is expected that the improved plant will have a capacity of 2,400 hp. L. L. Nunn is manager.

SALT LAKE CITY, UTAH.—Kelsey & Young, of Salt Lake City, engineers for the hydro-electric plants to be constructed by the Salt Lake Public Service Company, writes that no contracts have been let except for the material for the pipe lines. Some of the work, grading for pipe lines, constructing diverting dam, etc., is being done by day labor, and probably the greater part of the work will be done in this manner. The distributing system and steam heating plant is being constructed under the supervision of W. H. Schott, American Trust Building, Chicago, Ill.

ALEXANDRIA, VA.—The National Electric Supply Company will rebuild its plant, which was recently destroyed by fire, entailing a loss of $75,000.

NORFOLK, VA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 27, for the erection of a power house, oil house, etc., at the navy yard, Norfolk, Va. Application for proposals should refer to Schedule 238. H. T. B. Harris, Paymaster-General, U. S. N.

SPOKANE, WASH. — The Interstate Telephone Company has increased its capital stock from $20,000 to $100,000.

TACOMA, WASH.—Merle J. Wrightman and C. E. Muckler have made application to the City Council for an electric railway franchise in this city. The line is to run from Tacoma to Seattle.

EVERETT, WASH.—The Snohomish Valley Railway Company of Snohomish, has applied to the City Council for a franchise for a right of way through Everett for an interurban line that is projected from Monroe and the Cherry Valley district through Snohomish and Everett to Seattle.

SPOKANE, WASH.—The Washington Water Power Company will soon commence the construction of a large steam power plant to reinforce the present system and as an auxiliary thereto. D. L. Huntington, general manager of the company, states that the location has not yet been determined. Barstow & Company, of Portland, Ore., have been engaged to prepare plans and supervise the construction of the plant. The work will be done by the company under the direction of the engineers.

NORTH YAKIMA, WASH.—The City Council has granted a franchise to the Inter-Valley Traction Company for an electric railway system.

JANESVILLE, WIS.—At a special session of the Council, held Oct. 22, a franchise was granted to H. H. Clough, of Elyria, Ohio, who proposes to build the Madison-Janesville electric line. Permission was given to lay tracks on all the streets, and provides that the local line street railway line be taken over. The privilege of furnishing electricity for light and power was given.

CHELAN, WASH.—The Chelan Electric Company has acquired riparian rights on the Chelan River, between Chelan and Chelan Falls, west of Spokane, and will erect a power plant to furnish electricity to operate an electric railway from the town of Wenatchee northward along the Columbia River, with a branch line to Lake Chelan, and up the Okanogan River to the northern boundary of the state. The plant will also furnish electricity for lighting the towns of Chelan, Wenatchee, Waterville, Orondo and other points along the Columbia River, and will also pump water for irrigating purposes from the river. The company will also furnish electric energy for operating the line of the Great Northern from Wenatchee to Seattle, a distance of 160 miles, and for lighting various towns along the way. J. T. McChesney, of Everett, is president.

GREEN BAY, WIS.—The Incandescent Light Company, of Cincinnati, Ohio, is installing a new electric lighting plant in the Broadway House, on the west side.

FISH CREEK, WIS.—The officers and directors of the Door County Telephone Company have voted to commence immediately the rebuilding of its line from Sturgeon Bay northward.

MADISON, WIS.—A syndicate of New York capitalists is negotiating for the purchase of the Madison Gas & Electric Company and the Madison & Interurban Traction Company. The purchase, if consummated, will involve about $2,500,000.

MILWAUKEE WIS.—The city can now proceed with the building of a municipal lighting plant. In Judge Ludwig's court the local company, which had obtained a temporary injunction preventing the city from using $60,000 appropriated for the purchase of a site for the lighting plant, withdrew its objections and the injunction was dissolved, so far as money appropriated from a bond issue is concerned, but stands as against the water fund. The money already has been provided from a sale of $150,000 worth of bonds. The Alpeter site has been purchased and the Board of Public Works has entered into a contract with Robert W. Hunt & Company, of Chicago, Ill., for plans for construction and installation of the plant.

PRINCE ALBERT, CAN.—The Board of Trade has selected Charles H. Mitchell, of Niagara Falls, to investigate the power resources of the North Saskatchewan, with a view to developing the same.

GRAND VIEW, MAN.—T. A. Burrows is interested in the construction of an electric light plant.

WINNIPEG, MAN.—At a special meeting of the City Council held Oct. 20 Mayor Sharp signed the agreement with Cecil B. Smith, the Ontario power expert, while the power committee agreed to immediately appoint a board of three consulting engineers with Mr. Smith. The power committee and members of the City Council will at once visit Point du Bois, the site of the municipal water power and look over the field, so as to be prepared to go ahead with the development which according to Mr. Smith's estimate will involve an expenditure of $3,500,000.

BARRIE, ONT.—Frederick Nichols, of Toronto, has applied to the Barrie Council for a 25-year franchise for a street railway, with exclusive rights for local business

WELLAND, ONT.—The Town Council has awarded the contract for lighting the town to the Stark Electric Company, of Toronto. It will furnish 2,000-cp arc lamps for all-night service at $40 per lamp per year.

NEW LISKARD, ONT.—A hydro-electric plant is being erected by K. Farrah, which will supply electricity for light and power in the town. The plant is situated about two miles from New Liskard. The equipment for the plant has been furnished by the Allis-Chalmers-Bullock Company, Ltd.

Company Elections.

NEW YORK, N. Y.—At a recent meeting of the directors of the Long Acre Electric Light & Power Company, Edgar Van Etten, William J. Clark and William H. Lamprecht were elected members of the board. William Harris, president of the company, states that plans are being prepared for the company to begin work under its franchise. This company will be the operating company for the Manhattan Transit Company, now controlled by John Sheehan, to furnish the city of New York with electric light at a greatly reduced cost.

New Incorporations.

GADSDEN, ALA.—Articles of incorporation have been filed for the Citizens Light & Fuel Company, with a capital stock of $75,000. J. H Hammond is president.

HUNTSVILLE, ALA.—Articles of incorporation have been filed by the Huntsville & Birmingham Electric Railway Company for the purpose of constructing and operating an electric railway from Huntsville to Birmingham through Marshall, Cullam and Blount counties. The officers of the company are: C. S. Briggs, of Joppa, president; L. J. Hanners, of Cullman, vice-president; T. W. Riddle, of Holly Pond, secretary; F. T. Petty, of Huntsville, treasurer and general attorney.

IDAHO SPRINGS, COL.—The Honest John Power & Improvement Company has been formed and is raising capital of $150,000, to supply electricity for power and lighting to a district in the very heart of the Clear Creek mineral country. Headquarters of the company are at Denver. The officers are Dr. R. S. Craft, president; Dr. A. H. Daniels, vice president, and Mr. H. G. Fowler, secretary and treasurer.

FISHER, ILL.—A license has been issued for the incorporation of the Fisher Telephone Company, with a capital stock of $5,000. The company is capitalized at $5,000.

STILLWATER, MINN.—Articles of incorporation have been filed by the City Electric Light Company with a capital stock of $10,000. The incorporators are George B. Meyer and others.

STILLWATER, MINN.—A corporation has been formed under the name of the St. Croix Electric Light Company. It is subsidiary of the

Western Gas & Investment Company, of Chicago, Ill., which owns the gas and electric light plants in this city and the power plant at Apple River, from which electric energy is transmitted to this city. The new incorporation will have control of the sub-station, now under construction in the city. The capital stock is $10,000, with an authorized indebtedness of $200,000. The incorporators are George Mayer, of Chicago, Ill.; Edward H. Bingham, of Hinsdale, Ill.; J. G. W. Johnson, of Stillwater, Minn.

BATH, N. Y.—The Hornell, Bath & Lake Keuka Railway Company has filed articles of incorporation to construct an electric road 46 miles long. The company is capitalized at $1,000,000.

NYACK, N. Y.—The West Shore Traction Company has been incorporated with a capital stock of $250,000, to operate a street railway in Orangetown, Piermont, Grand View, South Nyack, Congress, Haverstraw, and other places in Rockland County. The directors are Frank J. Whan, A. J. Whan, E. J. Welsh, N. E. Heine, G. P. Fall, G. S. Fulton, of New York City; A. S. Brown, Brooklyn; E. G. Roff, Jr., Orange, N. J., and E. A. Hilton, Paterson, N. J.

TOLEDO, OHIO.—The People's Heat & Power Company has filed articles of incorporation with a capital stock of $400,000. The incorporators are Merwin Jackson and others.

CLEVELAND, OHIO.—The Cleveland Tramways Company has been incorporated with a capital stock of $50,000 by C. E. Saunders, H. J. Crawford, C. L. Brooks, R. F. Dennison and W. D. Whiting.

MASSILLON, OHIO.—Articles of incorporation have been filed with the Secretary of State for the Massillon & Northern Railway Company for the purpose of building an electric railway between Massillon and Akron by the way of Turkey Foot Lake. The incorporators are William A. Schuster, H. W. Loeffler, C. F. Dow, George W Kratsch and Louis A. Koons, of Massillon.

New Industrial Companies.

THE HUDSON ELECTRIC SPECIALTY COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $15,000. The directors are W. G. Hooke and J. J. Underwood, of New York.

THE MORGAN CITY ELECTRIC LIGHT COMPANY, of Morgan City, La., has been incorporated with a capital stock of $24,000, for the purpose of conducting an electrical supply business. The officers are B. M. Young, president and H. M. Young, secretary.

THE ATLANTIC ELECTRIC COMPANY, INC., of Norfolk, Va., has been chartered with a capital stock of $50,000, for the purpose of conducting an electrical construction and supply business in Norfolk. The officers are Walter Hitt, president, and H. N. Brown, secretary and treasurer.

THE SPRINGFIELD CRUDE OIL ENGINE COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in engines and electrical appliances, etc. The company has a capital stock of $500,000. The officers are: Thomas P. Robinson, president, of Boston, Mass.; William F. Miller, secretary, of Boston, Mass.

Legal.

TELEPHONE SUBSCRIBER'S RIGHTS.—The Chicago Telephone Company has won an important victory in a decision by Judge Winder that a subscriber has no right to attach private extension apparatus to the main lines of the company, holding that the company has the right to control its own system and that the attachment of private exchanges might interfere with the service of other subscribers. The court said, however, that the rental charged for extensions is unreasonable.

DEATH FROM CONTACT.—In the suit of Morhard versus the Richmond, S. I., Light & Railroad Company, the Supreme Court, Appellate Division, of New York, has denied the appeal of defendant against the verdict and for a new trial. The plaintiff was found dead in his cellar from contact with a wire while lighting a lamp connected to a transformer secondary. The points in the decision are: (1) In an action for death by wrongful act, plaintiff must make it appear with reasonable certainty that the injury was inflicted as the result of defendant's negligence, and the jury cannot be permitted to arrive at a verdict by speculation or guesswork. (2) In an action against an electric light company for the death of a person alleged to have been killed by coming in contact with a wire which defendant had negligently allowed to become charged with a dangerously high voltage, evidence *held* to justify submission to the jury of the question of defendant's negligence. (3) An electric light company maintaining wires charged with a voltage so high as to be deadly is required to exercise a high degree of care to protect persons using the current for domestic lighting. (4) In an action for negligence causing the death of a dentist 37 years old, having a family of four children and earning an income of from $17,000 to $20,000 a year, a verdict for $40,000 was not excessive.

ERECTION OF MUNICIPAL PLANT.—One of the aspects of municipal plants was brought out recently in the U. S. Circuit Court at Trenton, N. J., when Judge Lanning rendered an opinion in the suit of C. E. Hewitt & Co., of New York, against the borough of Park Ridge, Bergen County. The Hewitt Company sued to recover money due for the erection of a lighting plant. The judgment rendered was for $6,262.88 with interest from July 5, 1905, and cost of suit. The Hewitt Company contracted with the borough in July, 1904, for the erection of a lighting plant to cost $16,540.40. The company was to receive an additional 35 cents per cubic yard for all excavation of earth, and $4.50 per cubic yard for all excavation of rock in preparation for the building. A quantity of rock and earth was excavated. The work was to be finished in ninety days, but this part of the contract was broken by the borough authorities, who allowed the contractors indefinite time to finish the work. The work was completed and the borough officials refused to pay. The suit was brought for a balance of $9,541.51. The borough, through its counsel and officials, fought the case, alleging that the provisions of the contract had not been carried out by the contractors, and claimed to be at a loss of $20,000, and filed cross bills seeking damages in this amount. In his decision Judge Lanning found for the claim of the plaintiffs less $3,278.63.

THE KELLOGG SUIT.—The Illinois Supreme Court has recently decided a very interesting case, which has been watched with interest not only by those acquainted with the Kellogg Switchboard & Supply Company's situation, but by others interested in the legal points involved. It will be recalled by readers of this paper that several years ago the majority of the stock of the Kellogg Switchboard & Supply Company, formerly owned by Milo G. Kellogg was purchased by men identified with Bell telephone interests. This stock was sold during an illness of Mr. Kellogg by his representative who held his power of attorney. A fight was begun in the courts to regain control of this stock. Several minority stockholders filed a bill in the Circuit Court of Cook County against the American Telephone & Telegraph Company, the Western Electric Company, the Kellogg Switchboard & Supply Company, Milo G. Kellogg, Wallace L. De Wolf and various others to prevent the consummation of an alleged scheme to control the business of the Kellogg Company in the interests of the American Telephone & Telegraph Company. The Circuit Court dismissed the bill on demurrer and the Appellate Court of the first district approved this finding. It is held by the Supreme Court that the lower courts were in error and the petitioners were entitled to the relief prayed. Taking up the general principle involved, the court says that no corporation can legally secure control of the capital stock of another by purchase for the purpose of stifling competition or operating it to this end. The principle laid down is certainly a broad and far-reaching one, if it is to be applied generally.

OPPOSING A POWER DAM.—Attorney-General Hampton L. Carson, of Pennsylvania, has filed in the Court of Common Pleas at Harrisburg, Pa., a bill in equity against the McCall Ferry Power Company, seeking an injunction to restrain the company from erecting a dam at McCall Ferry across the Susquehanna River. The Attorney-General states in his bill that the dam, which is now in the course of construction, constitutes and will constitute an invasion of the rights of the Commonwealth in the shape of a continuing and permanent substantial encroachment on the Susquehanna River as a public highway; that it will be a public nuisance and destroy for the future the navigation of the river. He also contends that the McCall Company is about to act far beyond its chartered rights and powers and is unsurping franchises, authority, powers and privileges unauthorized by law. The bill also states that under the charter of the defendant the operations of the company must be confined to the districts for which it was chartered, and that the object of its great enterprise to supply power to distant points is beyond its charter. The company is also acting in an unlawful manner, the bill cites, in acquiring or attempting to acquire the rights of the Susquehanna Canal and Power Company and the Susquehanna and Tidewater Railroad Company, inasmuch as the two last mentioned companies have abandoned their franchises and forfeited their corporate rights. The bill also states that the conduct of the three defendants is in violation of legal agreements and charters entered into and obtained under the legislation of Pennsylvania and Maryland, by which the citizens of Pennsylvania have acquired rights through quasi-public corporations to unobstructed canal navigation from Columbia, Lancaster County, to tidewater at Havre de Grace, Md.—rights which in the future may be of great value on an interstate highway.

Personal.

MR. T. K. CUMMINS has been elected treasurer of the Edison Electric Illuminating Company of Boston, as well as a director, succeeding in the latter capacity Mr. H. R. Cabot.

MR. R. B. STICHTER, general superintendent of the Sherman Gas & Electric Company, Tex., has gone to Dallas, Tex., to take charge of the operating and of the properties controlled there by the Dallas Securities Company with headquarters in the Juanita Building.

MR. F. H. ALTEKAMP has been appointed chief electrician of the Bath Iron Works, Bath, Me. Mr. Altekamp has been with the General Electric Company for the past 16 years and for six years was in the Norfolk Navy Yard in charge of the electrical department.

MR. N. C. KINGSBURY has resigned his position with the Jeffrey Manufacturing Company, of Columbus, Ohio, to become vice-president of the Michigan Telephone Company. Mr. Kingsbury assumed charge of his new duties Nov. 1, and will reside in Detroit, Mich.

MR. O. BAERWINKEL, secretary and sales manager of the Excello Arc Lamp Company, started on Saturday, Oct. 27, for an extended trip throughout the West. He will visit Louisville, Cincinnati, St. Louis, Indianapolis, Chicago, Milwaukee, St. Paul, Minneapolis and other large cities.

MR. GEORGE W. JACKSON, who acted as chief engineer and general manager for the construction of the extensive system of freight tunnels

under Chicago streets, has resigned to give his entire time to personal consulting work and the construction companies of which he is president. His office will be in the Borland Block, Chicago.

MR. HARRY S. NEW has resigned as president of the Indianapolis Telephone Company, of Indianapolis, Ind., and as vice-president of the New Long Distance Telephone Company. He has been succeeded in said positions by James S. Braily, Jr., of Toledo, Ohio. As president of both companies Mr. Braily will spend nearly all of his time in Indianapolis, looking after the building of the company's new fireproof exchange, which will cost upwards of $50,000.

MR. FRANK McMASTER, who is well known throughout the Middle West, has been appointed sales engineer for the street lighting department of the Nernst Lamp Company, with headquarters at Chicago. Sixteen years ago Mr. McMaster introduced the Cutter street lighting specialties to western stations, afterwards covering the same territory for the Electric Appliance Company and the Fort Wayne Electric Works. He will now make a specialty of adjusting street lighting difficulties, for which work his experience has well fitted him.

MR. J. E. McGILLIVARY, district manager of the Pacific States Telephone & Telegraph Company, at Walla Walla, Wash., has tendered his resignation and expects to be relieved of the management of the Walla Walla exchange by the first of the year. He expects to remove to Seattle where he will go into business for himself, engaging in the work of telephone engineering and construction. He is one of the best known telephone men in the northwest. He has been in the employ of the Pacific States Telephone & Telegraph Company for 11 years and has held important positions with the company at various points on the Coast.

MR. EDWARD SCHILDHAUER, of the engineering department of the Chicago Edison Company, has been appointed assistant engineer of the Isthmian Canal Commission, and will have charge of the design of electrical and mechanical work for the Panama Canal, including the necessary power houses and lock operating machinery. Mr. Schildhauer is a graduate of the University of Wisconsin in the class of 1897. His training since graduation has been with J. G. White & Company on interurban railway construction and since 1898 in the engineering work of the Chicago Edison Company where he has had charge of the design of many important recent installations. For the present he will be located at Washington.

MR. G. P. ROBINSON.—Mr. George P. Robinson was recently promoted to general superintendent of the Pacific States Telephone and Telegraph Company, with headquarters at San Francisco. Upon the completion of his course of study at the University of Wisconsin, Mr. Robinson entered the employ of the Wisconsin Telephone Company and worked his way up to the position of traffic manager. He left Milwaukee five years ago to become traffic manager of the Central Union Telephone Company, having as his territory the States of Ohio, Indiana and Illinois. Three years ago, upon the return of President John I. Sabin to the Coast, he induced Mr. Robinson to go west with him to assume a still more responsible position with the company there. The Pacific States Company has as its field of operation all those States west of the Rocky Mountains, extending from British Columbia south to Mexico. In his new position, Mr. Robinson has direct control over more than 8,000 employees. Mr. Orsannis Cole, of Milwaukee, has been placed in the position of traffic manager of the company by Mr. Robinson.

MR. C. A. S. HOWLETT, who was formerly a contracting engineer for the Western Electric Company, Chicago, has been appointed manager of the power apparatus sales department of the Chicago office, to succeed Mr. Alfred McEwen, who has resigned. Mr. Howlett is well known in the electrical engineering field in the Middle West. He obtained his technical training at the Lawrence Scientific School, Harvard University. After obtaining a practical experience in the shops of the General Electric Company at Lynn, he entered actively the commercial engineering field. He is a member of the A. I. E. E., the Western Society of Engineers, the Illuminating Engineering Society, and the Chicago division of the Business Science Club, composed of graduates of the Sheldon School of Scientific Salesmanship. Mr. Howlett is chairman of the general advancement committee of the Electrical Salesmen's Association and secretary of the Chicago division of the Rejuvenated Sons of Jove.

Trade Publications.

WIRING SPECIALTIES.—Bulletin No. 35 of the H. T. Paiste Company, Philadelphia, Pa., deals with rosettes, panelettes, baby knife switches, tapets and waterproof socket plugs.

SIGN RECEPTACLES.—An illustrated mailing card of Pass & Seymour, Inc., Solvay, N. Y., calls attention to the fact that P. & S. porcelain sign receptacles are simply economical, safe and durable and handy.

THE GREGORY ELECTRIC COMPANY, of Chicago, has just issued its November bargain sheet. In this are listed machines and electrical material actually in stock. Parties desiring immediate delivery can be accommodated at once from its immense stock, which embraces a very wide range of apparatus of all kinds.

PANEL BOOK.—H. Krantz Mfg. Co., 160-166 Seventh street, Brooklyn, N. Y., is just issuing a handsome "Panel Book," illustrating and describing its various types of panel boards. Each book will be numbered and duplicates will not be issued. The firm has been doing some very fine work in the panel board and switchboard field.

KNIFE SWITCHES.—Bulletin No. 19 of the H. Krantz Manufacturing Company, 160 Seventh St., Brooklyn, N. Y., contains an illustrated description and price list of fuse blocks, terminals and knife switches. The switches are built single-pole, double-pole, triple-pole or four-pole, single or double-throw for capacities of from 3 to 1,000 amperes at 250 volts and are designed on a basis of a density of 1,000 amperes per square inch.

SARCO SWITCHES are the theme of a very neat and clever little book—vestpocket size, prepared by the Bates Advertising Company for the Sarco Company, of 906 Sixth avenue, New York City, which has done so much vigorous work in introducing its Sarco key arm and pendant switches. The miniature book puts forward the arguments in favor of this switch neatly and tersely, and each page makes a point in a few words. It is noted that the key arm switch is sold also without its metal covering, when it is known as a canopy switch. In whatever style it is much handsomer than the ordinary black-key types, and is rapidly making its way into popularity for the best fixture practice. The little book now noted is sent out in an equally effective envelope.

THE "NOSCRU" SWITCH.—The Sarco Company, of 906 Sixth avenue. New York City, has brought out a compact well illustrated pamphlet devoted to its business in the key switch field, now embracing a number of meritorious novelties. Front place is given to the "Noscru" keyarm switch, which takes the place of the unsightly key socket on an electric light fixture, and is not only simple in its mechanism, but artistic in appearance; besides which it brings the control of the individual lights within easy reach. The elimination of screws is a great advantage. Space is also given in the pamphlet to canopy switches, pendant switches, long distance switches, and other devices bearing the well known "Sarco" name.

STEAM TRAPS.—The Joseph Dixon Crucible Co., Jersey City, N. J., has published a very interesting pamphlet on the subject of steam traps. It is an illustrated description of the several varieties, with valuable suggestions, reprinted from a series of articles by Mr. W. H. Wakeman in *Graphite*. Some steam users seem to think that a steam trap is only a luxury to be enjoyed by those who have expensive plants in operation and wish to show many extra appliances which might be dispensed with. and not be missed. This is a great mistake, as a trap is valuable according to the cost of fuel that must be burned to make the steam. Certain it is that this pamphlet is well worth most careful reading for it is instructive as well as interesting.

ELECTRIC RAILWAY SUPPLIES.—The General Electric Company, from its supply department, Schenectady, N. Y., has issued a large and handsome catalogue, No. 7601, devoted to electric railway supplies. It is bound in stiff linen covers, and contains 230 illustrated pages, the size being a quarto. Large as it is, no motors or heavy apparatus of any kind is included. In other words, it is devoted to line material, including, however, lamps and other supplies that go on the railway circuits. Attention is called particularly to the new material for catenary construction. Note is also made of the high grade of mixture employed by the company in all composition castings. It is pointed out that all frogs and crossings are made with straight underrun.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has been circularizing the trade on its C. E. Co. Universal Portable. This portable is universal in the true sense of the word, because it combines all of the desirable features of any adjustable portable, and in addition is at once light in weight, strong, durable and ornamental. It throws the light just where it is wanted and can be folded into a small space when not in use. No screws or nuts are necessary to tighten and the solid cast base weighing 5½ pounds is so heavy that the portable cannot be easily knocked over. The bottom of the base is felt-covered, so that it will not mar or injure a polished desk. The "Universal Portable" is sold at a moderate price, and it is suggested that any one interested write the Central Electric Company for prices and complete information concerning this lamp.

News of the Trade.

DOSSERT & COMPANY, of New York, announce that they have received notice from their representative in Milan, Italy, that the Dossert solderless connectors exhibited at the Universal Exhibition, Milan, 1906, were awarded a gold medal.

STREET DECORATIONS.—The street decorations at the convention of the American Street Railway Association, held in Columbus, were one of the features of the convention. These decorations were made entirely of moulded mica weatherproof sockets supplied by the H. W. Johns-Manville Co., through its Cleveland office.

THE SIMPLEX ELECTRICAL COMPANY, of Cambridge, Mass., has purchased the J. A. Stubbs estate at 109 and 111 Franklin street and 29 Sidney street, on which it will erect an addition to its plant in the near future. The company has recently made an important improvement in its equipment by replacing two old horizontal tubular boilers with a 400-hp water tube boiler.

CHICAGO PNEUMATIC TOOL.—On account of the rapidly increasing popularity of Franklin compressors manufactured by the Chicago Pneumatic Tool Company, notwithstanding the fact that extensive improvements and additions were made to its Franklin plant the current year, the business has grown beyond its capacity and it is now adding another 150 feet to its machine shop, which will increase its present capacity from 55 to 70 compressors per month.

CENTURY MOTORS.—The Century Electric Company, of 494 North Fourth Street, St. Louis, Mo., reports that the demand for its single-phase, self-starting vertical motors for direct connection to centrifugal pumps, etc., has surpassed its most sanguine expectations. These motors have

now been on the market about a year, and it would seem that the vertical type is becoming more popular all the time. The company is making them not only for standing on feet, as is usual in this type of motor, but they can also be bolted to any vertical support.

ECONOMY LAMP COMPANY, of Warren, O., has had to erect a large new factory this summer. It is a commodious two-story brick building, following the lines of the most modern ideas in lamp factory construction. It is equipped with new and up-to-date machinery, and is one of the finest and best of its kind in the United States. Mr. H. B. Ramey, the sales manager, says: "While many improvements have been made in new lamps, we have not been asleep ourselves and many improvements have been made in renewed lamps by us. We have installed some new and original machinery that has greatly improved our product. We are the manufacturers of the well-known "Economy" and "Bright" incandescent lamps; they have both been on the market for years and have earned an enviable reputation. These lamps are as good as any lamp on the market. Our company was organized in 1890 and we are the largest renewers of lamps in the United States. We are selling our product all over this country and in many foreign countries. This factory makes the third one that we have occupied since we started and each of the other facfories were outgrown. We are one of the pioneers in the renewing of lamps and on account of our large output are prepared to give our customers a close assortment and make prompt deliveries. The Erie and Baltimore & Ohio Railroads pass by our factory."

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTRO-THERAPEAUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia. Next meeting, New York City, October, 1906.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West 31st St., New York. Next annual meeting, New York, Dec. 4-7, 1906. Spring meeting, Indianapolis, Ind., May, 1907.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Geo. R. Stetson, New Bedford, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio. Next meeting, November 7, 1906.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRIC CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo. Next meeting, St Louis, Mo., Dec. 13, 1906.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November, 1906.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Staveley, Royal Insurance Building, Montreal, Can. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, R. A. Davidson, 58 William St., New York. Next meeting, November, 1907.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot. 4 Irving Place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia. Next meeting, Clinton, Ia., April, 1907.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Clinton, Ia., May, 1907.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Sioux City, Ia., March 12-14, 1907.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., Oct. 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin. Philadelphia, Pa.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Next meeting, Columbus, O., last Thursday in April, 1907.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, O. Next meeting, Akron, Ohio, Nov. 15-17, 1906.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting Sioux Falls, S. D., Jan. 9 and 10, 1907.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, E. B. Meginnis, Dallas, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, Jr., 114 Liberty St., New York.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Next meeting, March, 1907.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

WESTERN SOCIETY OF ENGINEERS, Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 23, 1906.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

833,208. DOUBLE THROW ELECTRIC SWITCH WITH INDICATOR; Edward M. Hewlett, Schenectady, N. Y. App. filed July 11, 1903. Relates to a switch adapted to control two separate circuits when swung into different angular positions. An indicator is provided to swing between two index marks by a lost motion connection with the switch arm which has a greater angular movement than the indicator.

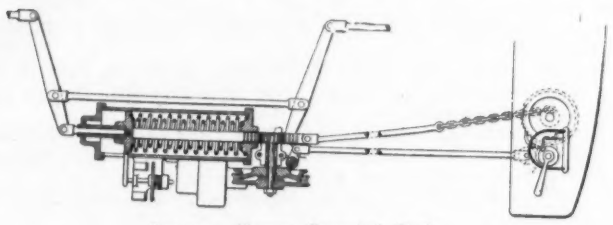
833,733. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Dec. 23, 1902. In a telephone system, the combination with a telephone-line, a line-signaling device therefor, means controlled from the substation for establishing a consequent pole on said device, and means for shifting said pole upon the establishment of a connection with the line, substantially as described.

833,741. ELECTROMAGNET; Hans H. Hansen, Chicago, Ill. App. filed May 1, 1905. The two cores of an electric bell magnet are wound in separate circuits and one circuit has capacity therein so as to dephase such coil with respect to the other.

833,745. TELEPHONE TRANSMITTER-ARM; John A. Loff, Chicago, Ill. App. filed Dec. 6, 1901. Details of a transmitter arm and standard by which a yielding connection is made between the two.

833,760. REGULATING APPARATUS; Elmer A. Sperry, Cleveland, O. App. filed June 6, 1905. The motor armature has two separate commutators and brushes mounted on equalizing levers. Means are provided for pressing the equalizing levers to bear the brushes equally against the two commutators.

833,765. SIGNAL SYSTEM FOR RAILWAYS; Maximillian G. Voigtlander, Harrison, O. App. filed Nov. 14, 1904. The track is provided with contact plates alongside of the track rails and which are adapted to be electrified or not according to the position of the switch



834,107.—Power Operated Brake.

point. The car trucks have a depending shoe which contacts with these plates to establish signals on the train.

833,776. AUTOMATIC SWITCH INDICATOR; Edward F. Coffin, Columbus, Tex. App. filed Dec. 18, 1905. The track rail and switch point are recessed to receive a specially constructed circuit closing switch which closes circuit to a plate alongside the track and which in turn contacts with the tappet on the train to establish an alarm circuit.

833,778. FASTENING DEVICE FOR SWITCHBOARD CONNECTING CORDS; Edward B. Craft, Chicago, Ill. App. filed Dec. 7, 1904. Relates to the means for connecting the terminals of the flexible cord circuit of a telephone switchboard to the parts of the operator's key.

833,805. ELECTRICAL SELECTING APPLIANCE; Charles E. Scribner, Jericho, Vt. App. filed Dec. 18, 1905. The combination with a contact member, of a contact-anvil therefor, mechanism for giving said member two movements, away from and into engagement with its anvil, respectively, and a shunt about said member and anvil closed during one of the movements of said member.

833,816. TELEPHONE-CIRCUIT SIGNALING APPARATUS; James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill. App. filed July 3, 1905. In a telephone system for selectively signaling the substations on a four-party line, a generator for signaling-currents; an electromagnetic pole-changing device; a key for operating and controlling the movement of said device; and an electromagnetic switch for reversing the circuit connections of said generator with the line conductors.

833,817. TELEPHONE SWITCHING AND SIGNALING APPARATUS; James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill. App. filed March 12, 1906. Relates to modifications of the above.

833,866. TELEPHONE SYSTEM; Charles V. Beaver, Anita, Ia. App. filed Aug. 19, 1904. In, and between, telephone systems where different kinds of lines are used; means for connecting three or more lines, whereby a certain, distinct side, which includes the better side of each where one side of any is superior to the other, shall be connected, and the other side of these said same lines shall be connected, when any three or more of said lines are connected together.

833,870. UNDERGROUND CONDUIT; Horace B. Camp, Akron, O. App. filed Oct. 3, 1905. The usual tile conduit having rectangular openings is provided with separate tile sleeves within the openings, which receive the telephone cables. The purpose is to insure very accurate register of the conduit sections.

833,877. INSULATOR; Francis J. Grant, Chicago, Ill. App. filed Aug. 12, 1905. A porcelain insulator having a shank to receive the circuit wire and a portion at right angles thereto adapted to be attached to a wall or support. The recesses of the insulator are adapted to drain the water collected.

833,904. TELEGRAPHIC CODE; Daniel H. Wilcox, Buffalo, N. Y. App. filed Nov. 9, 1905. The code has dots and dashes but is designed to have the dashes first and the dots last in each character.

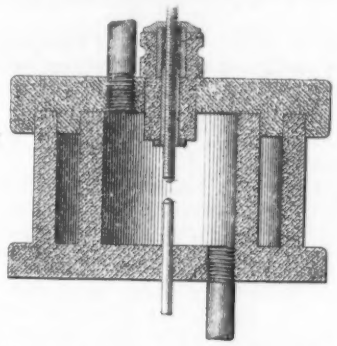
833,906. TELEPHONE SWITCHING AND BUSY-TEST APPARATUS; James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill. App. filed July 3, 1905. In a telephone system for connecting two central stations, a relay controlled by the plug and jack at the calling central station; a relay controlled by the plug and jack at the called central station; a third relay to control the main connecting-circuit from one central station to the other; and shunt-circuits around said third relay controlled respectively by the other two relays.

833,907. SIGNALING APPARATUS FOR TELEPHONE TOLL-LINES; James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill. App. filed July 3, 1905. Relates to modifications of the above.

833,968. ALTERNATING CURRENT CONTROLLER; David Larson, Yonkers, N. Y. App. filed Sept. 28, 1905. Relates to the control of elevators. The strength of the field circuit is varied by cutting out resistances, and special means are provided for varying the resistances in the three-phase armature circuit.

834,010. ELECTRICAL CONTROLLER; David Larson, Yonkers, N. Y. App. filed Nov. 4, 1905. Relates to modifications of the above.

834,054. SPARK GAP AND MUFFLER THEREFOR; Aaron E. Harrison, New York, N. Y., and Crowell M. Haslett, Jersey City, N. J. App. filed Sept. 26, 1905. In order to reduce the noise of spark or wire-



834,054.—Spark Gap and Muffler Teherfor.

less telegraphy, the patentee has an asbestos muffler in which the spark gap is enclosed. Means are provided for circulating air through the muffler.

834,084. HIGH POTENTIAL INSULATOR; Louis Steinberger, New York, N. Y. App. filed Mar. 24, 1905. A triple petticoated insulator in two parts. The petticoats of the insulator are made with sharp corners in a special way so as to avoid the collection of frost and sleet.

834,098. ALTERNATING-CURRENT MOTOR; Charles A. Ablett, Schenectady, N. Y. App. filed July 30, 1903. In an alternating-current motor, a stationary primary core, a primary winding thereon, a rotary secondary core, a secondary winding carried thereby, and means for changing the reluctance of the magnetic circuit of the secondary winding, whereby the self-induction of the secondary winding is varied.

834,100. OVERHEAD TROLLEY SYSTEM; Charles E. Barry, Schenectady, N. Y. App. filed May 1, 1905. Relates to trolley systems of the sort where it is desired to have room for persons to ride on the top of a car. The trolley conductor is hung on opposite sides of the road alternately as convenient, and a special overhead guiding wire automatically transfers the pole from one side to the other.

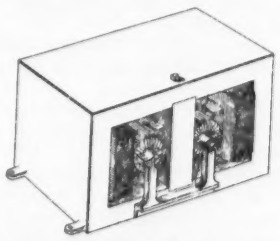
834,107. POWER-OPERATED BRAKE; Frank E. Case, Schenectady, N. Y. App. filed June 9, 1904. A trolley car brake system adapted to be operated electrically but without depending on the line voltage. A powerful spring is effective to set the brakes and a motor is geared to tension the spring to release them.

834,128. ELECTRIC SWITCH; Laurence A. Hawkins, Schenectady, N. Y. App. filed Feb. 1, 1906. A substitute for contactors for large motors. A series of knife blade switches have mechanical interlocking devices by which they can only be actuated in a predetermined order.

834,129. BLOCK SIGNAL SYSTEM; Laurence A. Hawkins, Schenectady, N. Y. App. filed Apr. 7, 1906. Designed to overcome defect of present railroad signal system where the rails are cross tied together. In present system breakage of a rail is not indicated by the signals. Patentee has a means for insuring operation of signals when one rail is broken, although they are cross connected or tied.

834,134. TROLLEY BASE; Henry Holland, Cleveland, O. App. filed Aug. 5, 1905. The base is swiveled to the top of the car by a ball-bearing raceway and the pole has a spiral spring which presses a sliding block against a pair of pins so as to swing the pole upward against the wire in either direction. Means are provided for rendering this spring inoperative when desired.

834,147. AUTOMATIC MOTOR CONTROL; Sam H. Libby, East Orange, N. J. App. filed May 21, 1904. The motor shaft is extended to form a lead screw which moves a shoe longitudinally to cut out resistances successively from the motor circuit.



12,543.—Electric Motor.

834,148. TRANSFORMER; Charles E. Lord, Norwood, O. App. filed Oct. 19, 1905. The transformer core is provided with specially arranged air passages by which it is cooled.

834,160. TRANSFORMER; Louis C. Nichols, Norwood, O. App. filed Oct. 19, 1905. Relates to another arrangement for cooling the cores and the windings of a transformer.

834,172. VAPOR ELECTRIC APPARATUS; Charles P. Steinmetz, Schenectady, N. Y. App. filed July 1, 1904. In a vapor electric apparatus, the combination of an envelope or container, electrodes therefor, one at least of which is of vaporizable material, and starting means therefor including a solenoid and a polarized magnetic core.

12,543. ELECTRIC MOTOR; Patrick J. Collins, Scranton, Pa. App. filed Aug. 14, 1900. A single field frame has four pole faces and two armatures revolved between the separate pairs of pole faces. The purpose is to provide a compact automobile motor in which the two armatures are separately connected to the rear wheels.